OXYPLETH™

Service Manual

Pulse Oximeter

Model 520A

August 31, 1992

Catalog Number 5693-90-00

Novametrix Medical Systems Inc. Wallingford, Connecticut, U.S.A. 06492.
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R Revision History

August 31, 1992 Release 00. This manual replaces all preliminary versions. Based on Revision 2.0 CPU software.

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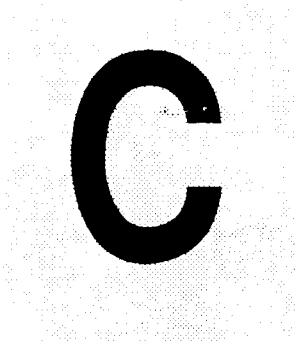

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1 Introduction

Purpose 1.1

This manual has been prepared for technicians servicing the Novametrix Model 520A Pulse Oximeter monitor. It presents technical information relating to the monitor's theory of operation, maintenance, calibration and repair. Refer to the Pulse Oximeter Model 520A User's Manual (Catalog Number 5693-23) for additional information.

Technology Description 1.2

Pulse oximetry is a non-invasive method of monitoring the oxygen saturation of arterial blood. Oxygen saturation monitoring is intended to be used in a variety of clinical situations including, respiratory therapy, anesthesia, the intensive care unit (ICU) and neonatal (NICU) and pediatric (PICU) intensive care units.

The Model 520A Pulse Oximeter provides reliable continuous measurement, display, and alerts for oxygen saturation (SpO_2) and pulse rate. The monitor can be powered from its rechargeable internal battery or from the AC Mains.

The Model 520A utilizes sensors containing two light emitting diodes (LEDs) and a photodiode. Each LED emits a specific wavelength of light (660 and 940 nanometers) through a pulsating vascular bed to the photodiode. Oxygen saturated blood absorbs different amounts of light at each wavelength as compared to unsaturated blood. Therefore, the amount of light absorbed by the blood in each pulse can be used to calculate saturation.

The Model 520A is calibrated to display "functional" saturation. This differs from the "fractional" saturation value displayed by most co-oximeters. Functional saturation is defined as:

$$\text{Functional Saturation} = \frac{HbO2}{100 - (COHb + METHb)}$$

HbO2 = Fractional Hemoglobin
COHb = Carboxyhemoglobin
METHb = Methemoglobin

This can be considered to represent the amount of oxyhemoglobin as a percentage of the hemoglobin that can be oxygenated. Dysfunctional hemoglobins (COHb and METHb) are not included.

Pulse Rate is calculated by measuring the time interval between detected peaks of the infrared light waveform. The inverse of this measurement is displayed as pulse rate.

The oxygen saturation and pulse rate values are displayed on monitor's displays. The displayed values are updated once each second. Presence of a pulse is shown as a waveform on the display and indicated audibly by a user selectable "beep".

The Model 520A must be used in conjunction with SuperBright™ Sensors. These sensors have an 8700 series part number (e.g., 8776 or 8791). An INCOMPATIBLE PROBE display message will indicate a non-SuperBright™ Sensor (e.g., 86xx series) is in use.

Conventions Used In This Manual 1.3

The following conventions will be used throughout this manual:

- Normal text will be shown in this type.
- Message Center alerts and displays will be shown in this type.
- The names of the front panel pushbuttons (keys) will be shown **In this type.**

Acknowledgments 1.4

SuperBright, Y-STRIP and Y-SENSOR are trademarks of Novametrix Medical Systems Inc. SARAcap is a registered trademark of Allegheny International Medical Technology, Inc. (PPG Biomedical Systems).

2 Patient Safety

The Model 520A Pulse Oximeter has electrically isolated inputs. Patient leakage current flowing from the instrument to ground is limited to less than 10 μA at 120 V, 60 Hz. Patient isolation is greater than 10 MΩ, 2500 V rms at 60 Hz. For maximum patient and operator safety, the following procedures are recommended;

- Keep the Model 520A and its accessories clean.
- Do not operate the Model 520A when it is wet due to spills or condensation.
- Do not operate the Model 520A if it appears to have been dropped or damaged.

Refer also to *Warnings* on page 4 and *Cautions* on page 5.

3 Warnings

Warning
Indicates a potentially harmful condition
that can lead to personal injury.

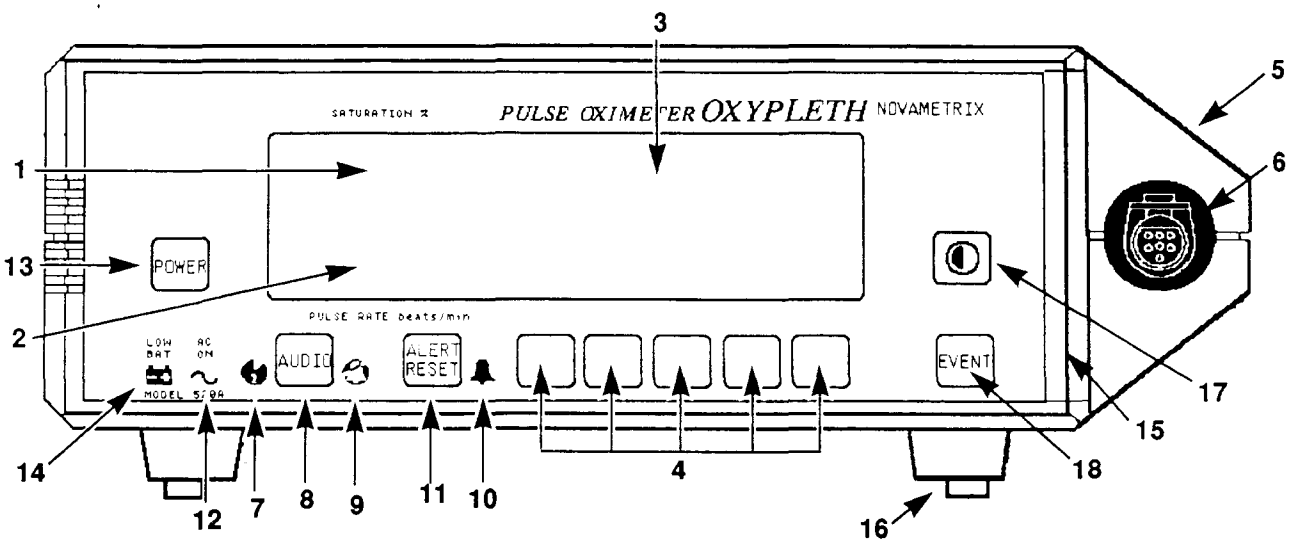
- **Explosion Hazard:** Do NOT use the Model 520A in the presence of flammable anesthetics. Use of this instrument in such an environment may present an explosion hazard.
- **Electrical Shock Hazard:** Always turn the oximeter off before cleaning it. Do NOT use a damaged sensor or one with exposed electrical contacts.
- **Patient Safety:** Extreme care should be exercised with neonates to assure continued circulation distal to the sensor site after application.
- **Failure of Operation:** If the oximeter fails to respond as described, do not use it until the situation has been corrected by qualified personnel.
- **Data Validity:** The Pulse Oximeter should NOT be used as a substitute for an ECG monitor. The oximeter's Pulse Rate display reflects the pulsatile flow found at the patient extremity connected to the sensor. This rate can be affected by many factors and may occasionally be "frozen".
- **Data Validity:** Do NOT attach a sensor distal to a blood pressure cuff. Valid data CANNOT be processed when the cuff is inflated. Attach the sensor to the limb opposite to the site used for the blood pressure cuff.
- **Data Validity:** Inaccurate SpO_2 and/or Pulse Rate measurements can be caused by any of the following:
  - Incorrect application or use of a sensor
  - Significant levels of dysfunctional hemoglobins such as carboxyhemoglobin or methemoglobin
  - Significant levels of indocyanine green, methylene blue, or other intravascular dyes
  - Exposure to excessive illumination such as surgical lamps - especially ones with a xenon light source, or direct sunlight
  - Excessive patient movement, venous pulsations, electrosurgical interference

4 Cautions

Caution
Indicates a condition that may lead to equipment damage or malfunction.

- Federal (U.S.A.) law restricts this device to sale, distribution, or use by or on the order of a licensed medical practitioner.
- No tension should be applied to the sensor cable.
- Avoid storing the oximeter and sensors at temperatures exceeding -10° C and +55° C (14° F and 131° F).
- Do not operate the monitor at ambient temperatures above 40° C or below 10° C (50-104° F).
- Never immerse the monitor in liquids.
- Do NOT sterilize the monitor.
- Do NOT sterilize the Finger sensor.
- Electric Shock Hazard. Do NOT remove covers. Refer servicing to qualified service personnel.
- Connect the line cord only to a grounded hospital-grade outlet.

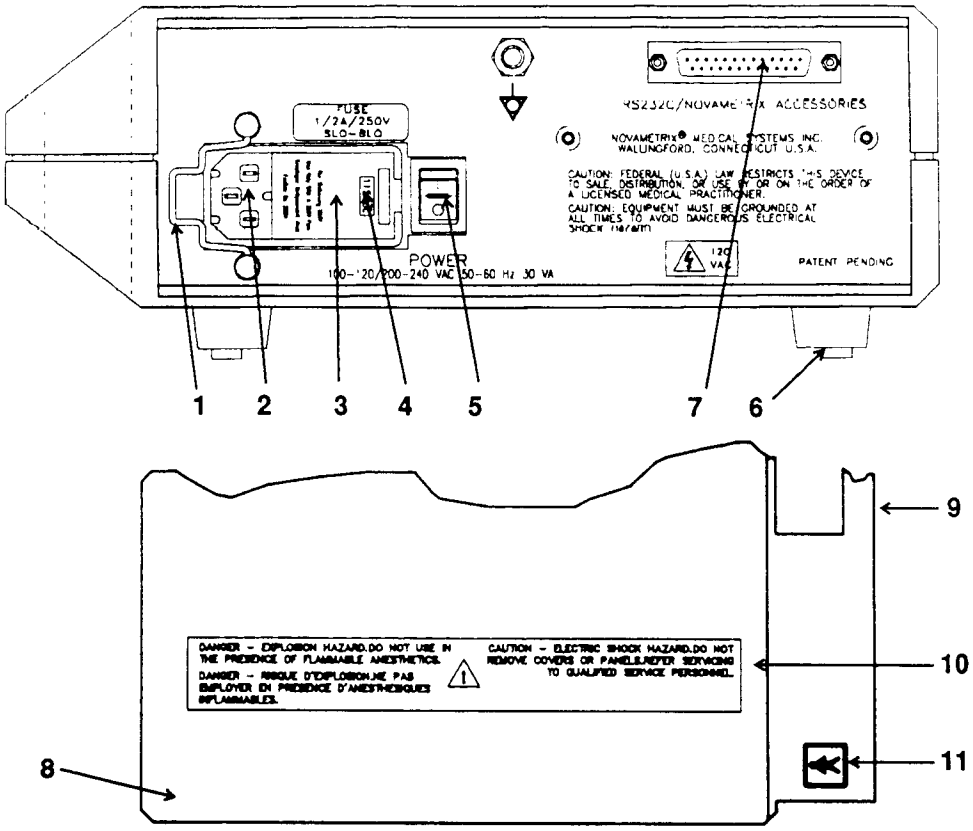
5 Front Panel



1. Saturation% Display Area; SpO_2 and alert limit settings are displayed here.
2. Pulse Rate Display Area; Pulse Rate and alert limit settings are displayed here.
3. Message Center; area where system messages are displayed. The functions of the softkeys (#4) are annotated here.
4. Softkeys # 1-5; Softkeys 1-5 (left to right) cause the action annotated in the lower half of the Message Center to occur.
5. Carrying Handle; monitor carrying handle molded into case
6. Sensor Input Connector; Connect SuperBright™ Sensors here. **Press tab on sensor connector to remove sensor. Do not twist connector.**
7. Two Minute Silence Indicator; Illuminates (yellow) when the **AUDIO** key is pressed. SpO_2 and Pulse Rate alarms are silenced for two minutes.
8. Audio key; Press and release **AUDIO** to turn on/off the two minute silence function. Press and hold (approx. 3 seconds) **AUDIO** to enable the Audio Off feature (unless disabled via Options Menu). Press and release to disable Audio Off.
9. Audio Off Indicator; Flashes (yellow) as a warning that the audible alarms have been disabled.
10. Alert Indicator; Flashes (red) when an alert/alarm occurs. Continues to flash until condition corrected and **ALERT RESET** is pressed.
11. Alert Reset key; Press **ALERT RESET** to disable any active alert indicators. Alerts will reactivate if alert condition still exists.
12. AC Power Indicator; Illuminates (green) when the monitor is connected to an AC (Mains) power source and the rear panel power switch is set to "I".
13. Power key; Press **POWER** to turn the monitor off and on.
14. Low Battery Indicator; Illuminates (red) when the monitor is powered from its internal battery and less than 30 minutes of battery power remain.
15. Red Alert Bar; Flashes (red) when an alert/alarm occurs (unless disabled via Options Menu). Continues to flash until condition corrected and **ALERT RESET** is pressed (unless "unlatched" by the user via the Options Menu).
16. Front Feet; Rubber tipped front feet (2). Kickstand; Two position kickstand (not shown) lifts front of monitor for viewing from above.
17. Contrast; Press and hold for display contrast adjustment, release when desired contrast is obtained.
18. Event; Press to mark an event in trend memory.

Figure 1. Front Panel Description

6 Rear & Top Panels



1. Line Cord Clip; This clip can be set around the line cord strain relief so that the cord cannot be pulled out of the connector.
2. Line Cord Connector; The AC (Mains) line cord attaches to the monitor here.
3. Fuse Compartment; The AC (Mains) line fuse(s) are inside this compartment. Pry open with small screwdriver.
4. AC Mains Voltage; The currently selected AC Mains input voltage is identified here.
5. AC Mains Power Switch; With switch in "O" position, AC Mains voltage does not enter monitor. With switch in "I" position, AC Mains voltage allowed into monitor to power unit and/or charge internal battery.
6. Rear Feet; Rubber tipped rear feet (2).
7. Serial Output Connector; Serial (RS232) data output here for use with Tele-Sat™ telemetry system, optional analog output module, and other RS232 interfaces. A female 25-pin "D" connector serves as the interface connector.
8. Top Cover
9. Carrying Handle; Monitor carrying handle molded into case.
10. Warning Label; Explosion and electrical shock warnings.
11. Patient Isolation Label; The Model 520A is Type BF equipment.

Figure 2. Rear and Top Panel Descriptions

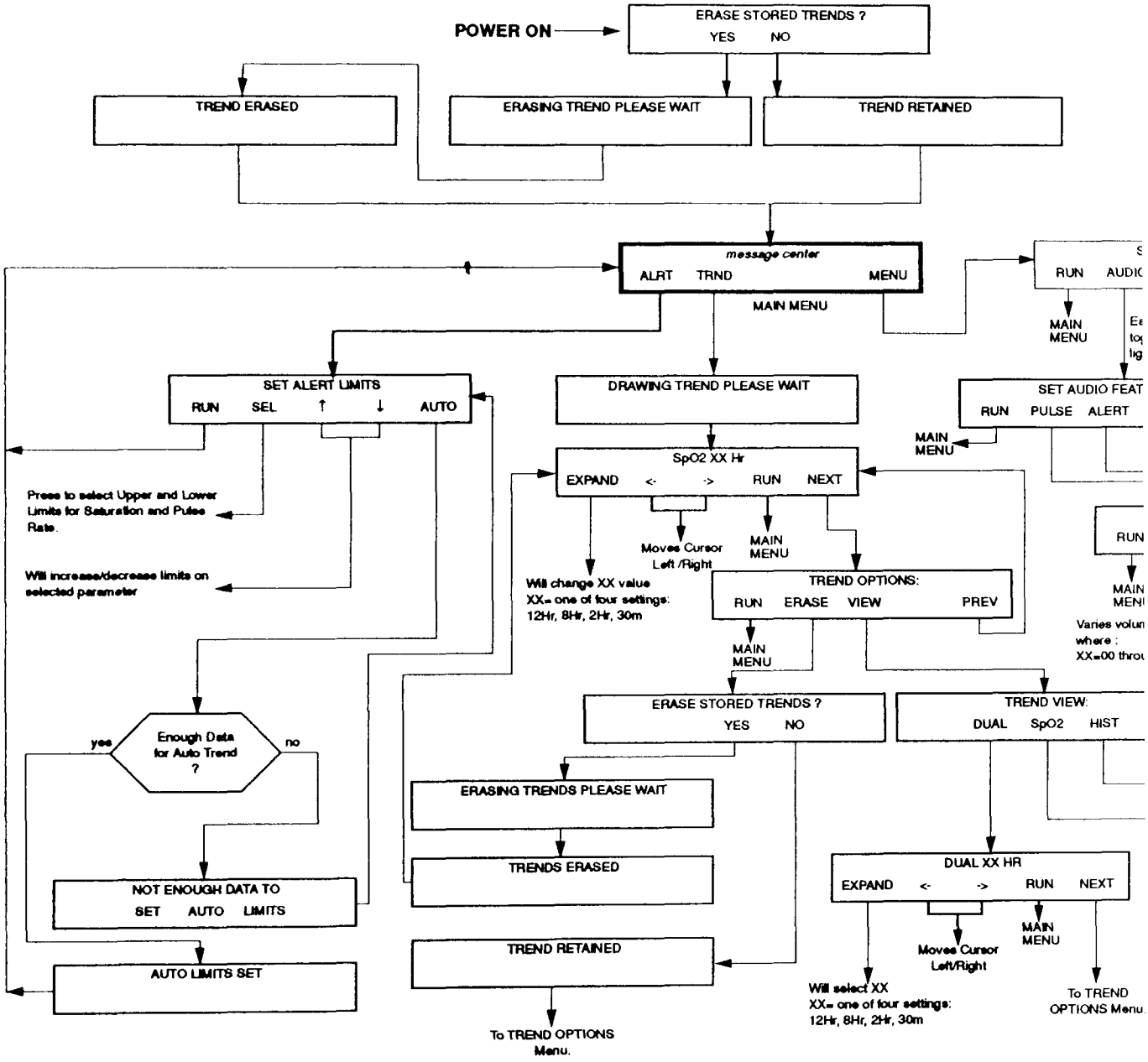
7 Summary of Operation

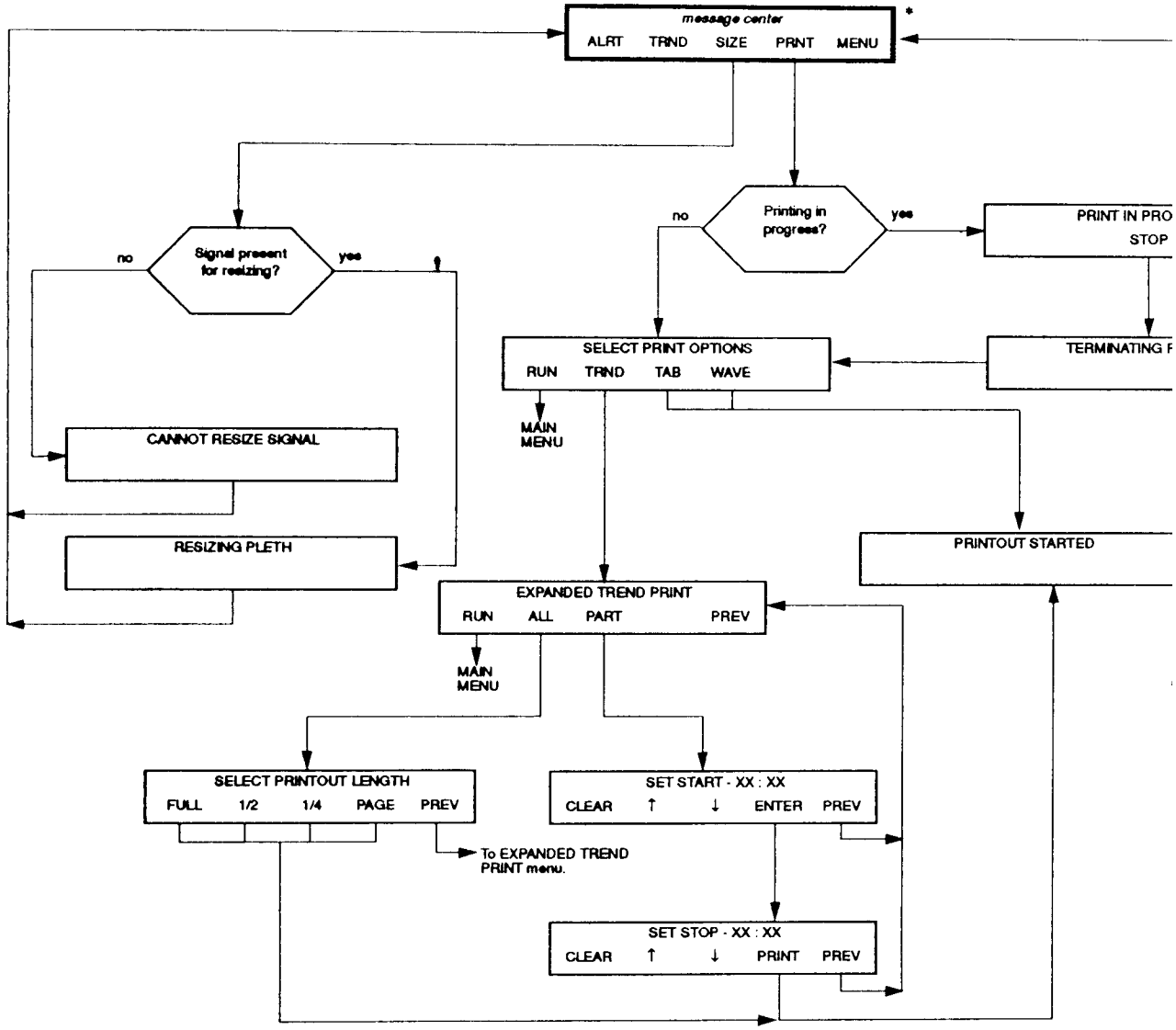
This section summarizes the operation of the Model 520A Pulse Oximeter. It is intended as a quick reference and refresher for persons who have thoroughly reviewed the Model 520A User's Manual (PN: 5693-23). Persons unfamiliar with the Model 520A should thoroughly examine the User's Manual before referencing the steps listed here.

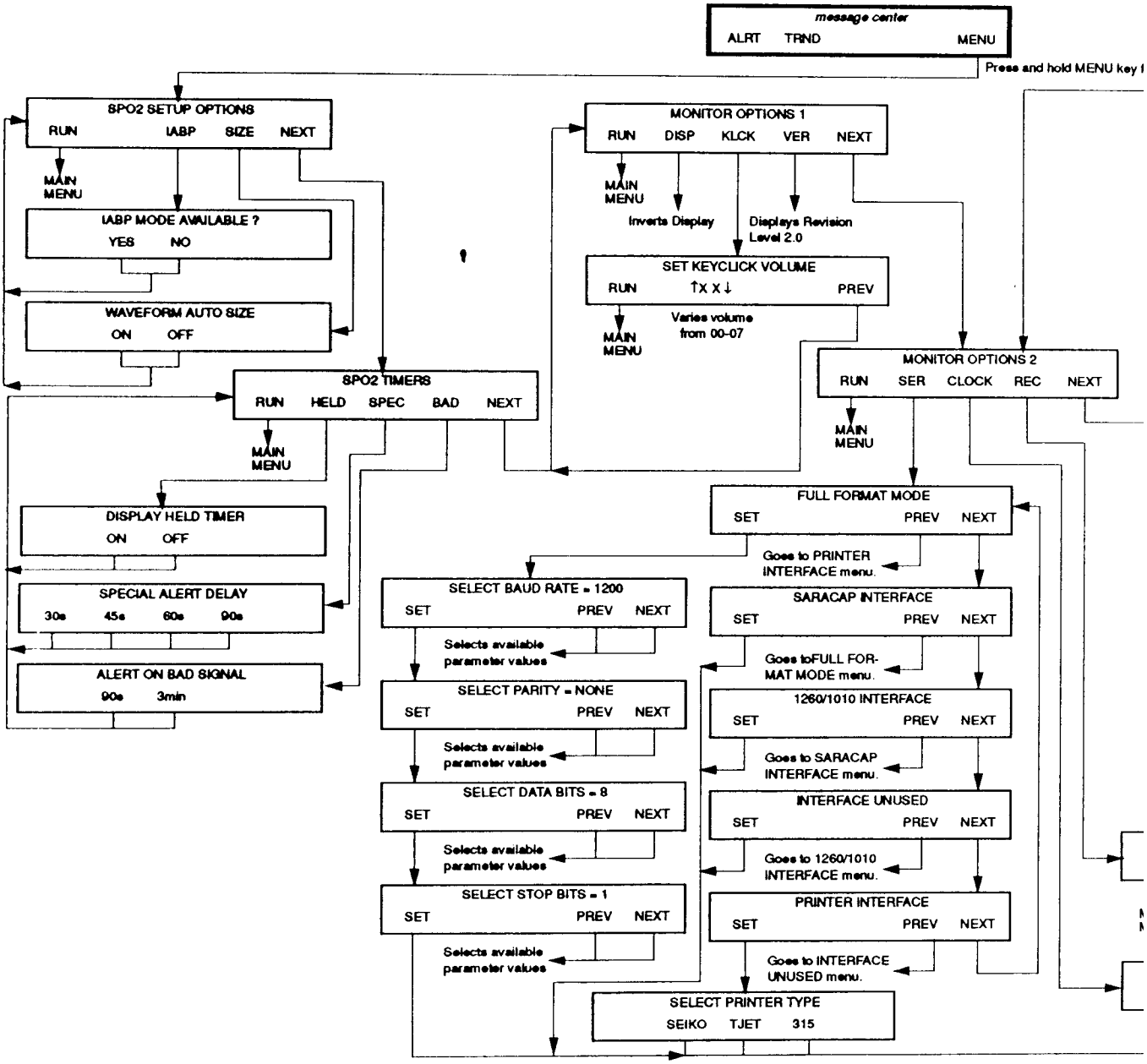
1. If powering the monitor from the AC line voltage; Connect the line cord to the monitor and plug into a properly grounded 3-wire outlet. Set the rear panel power (Mains) switch to the | (on) position.
2. Press the front panel **POWER** key to turn the monitor on. Verify the Message Center displays `Connect SPO2 Probe` after the self-tests are complete.
3. Use the Menu System to modify the operation of the monitor to best suit your application. The Menu System menus include:
   - **ALRT** softkey - Use **SEL** to select SpO2 or Pulse limits, then use the ↑ or ↓ to set the limit to the desired value. Note that the monitor will maintain a spread of at least 5 digits between the upper and lower limit values.
   - **TRND** softkey - enters Trend mode and draws trend memory on display.
   - **MENU** then **AUDIO** softkeys - Select **Pulse** to turn on/off and control the volume of the audible beep with each detected pulse. Select **ALERT** to control alert volume.
   - **MENU** then **AVG** - Select either 2 second or 8 second SpO2 averaging time.
   - **MENU** then **LITE** softkeys - toggles backlight between bright and dim.
4. Verify that the SpO_2 and Pulse Rate alert limit settings are consistent with your monitoring application.
5. Connect a SuperBright™ (87xx series) sensor to the front panel input. Apply the sensor to the patient.
6. Check that within several seconds the patient's SpO_2 and Pulse Rate are displayed on the monitor.
7. As necessary, refer to the appropriate sections within the User's Manual for detailed operating instructions and explanations.

8 Menu Tree

Each menu within the Model 520A Pulse Oximeter is diagramed on the following pages.


POWER ON
ERASE STORED TRENDS ?
YES NO
TREND ERASED
ERASING TREND PLEASE WAIT
TREND RETAINED
message center
ALRT TRND MENU
MAIN MENU
SET ALERT LIMITS
RUN SEL ↑ ↓ AUTO
Press to select Upper and Lower Limits for Saturation and Pulse Rate.
Will increase/decrease limits on selected parameter
yes
Enough Data for Auto Trend ?
no
NOT ENOUGH DATA TO SET AUTO LIMITS
AUTO LIMITS SET
DRAWING TREND PLEASE WAIT
SpO2 XX Hr
EXPAND <- -> RUN NEXT
Moves Cursor Left /Right
MAIN MENU
Will change XX value
XX= one of four settings:
12Hr, 8Hr, 2Hr, 30m
TREND OPTIONS:
RUN ERASE VIEW PREV
MAIN MENU
ERASE STORED TRENDS ?
YES NO
ERASING TRENDS PLEASE WAIT
TRENDS ERASED
TREND RETAINED
To TREND OPTIONS Menu.
RUN AUDIO
MAIN MENU
SET AUDIO FEAT
RUN PULSE ALERT
MAIN MENU
RUN
MAIN MENU
Varies volun
where :
XX=00 throu
TREND VIEW:
DUAL SpO2 HIST
DUAL XX HR
EXPAND <- -> RUN NEXT
Moves Cursor Left/Right
MAIN MENU
Will select XX
XX= one of four settings:
12Hr, 8Hr, 2Hr, 30m
To TREND OPTIONS Menu.


message center
ALRT TRND SIZE PRNT MENU
*
Printing in progress?
no
yes
PRINT IN PRO
STOP
Signal present for resizing?
no
yes
SELECT PRINT OPTIONS
RUN TRND TAB WAVE
TERMINATING F
MAIN MENU
CANNOT RESIZE SIGNAL
RESIZING PLETH
PRINTOUT STARTED
EXPANDED TREND PRINT
RUN ALL PART PREV
MAIN MENU
SELECT PRINTOUT LENGTH
FULL 1/2 1/4 PAGE PREV
SET START - XX : XX
CLEAR ↑ ↓ ENTER PREV
To EXPANDED TREND PRINT menu.
SET STOP - XX : XX
CLEAR ↑ ↓ PRINT PREV


message center
ALRT TRND MENU
Press and hold MENU key f
SPO2 SETUP OPTIONS
RUN IABP SIZE NEXT
MAIN MENU
IABP MODE AVAILABLE ?
YES NO
WAVEFORM AUTO SIZE
ON OFF
SPO2 TIMERS
RUN HELD SPEC BAD NEXT
MAIN MENU
DISPLAY HELD TIMER
ON OFF
SPECIAL ALERT DELAY
30s 45s 60s 90s
ALERT ON BAD SIGNAL
90s 3min
MONITOR OPTIONS 1
RUN DISP KLCK VER NEXT
MAIN MENU
Inverts Display
Displays Revision Level 2.0
SET KEYCLICK VOLUME
RUN ↑X X↓ PREV
MAIN MENU
Varies volume from 00-07
MONITOR OPTIONS 2
RUN SER CLOCK REC NEXT
MAIN MENU
FULL FORMAT MODE
SET PREV NEXT
Goes to PRINTER INTERFACE menu.
SELECT BAUD RATE = 1200
SET PREV NEXT
Selects available parameter values
SELECT PARITY = NONE
SET PREV NEXT
Selects available parameter values
SELECT DATA BITS = 8
SET PREV NEXT
Selects available parameter values
SELECT STOP BITS = 1
SET PREV NEXT
Selects available parameter values
SARACAP INTERFACE
SET PREV NEXT
Goes toFULL FORMAT MODE menu.
1260/1010 INTERFACE
SET PREV NEXT
Goes to SARACAP INTERFACE menu.
INTERFACE UNUSED
SET PREV NEXT
Goes to 1260/1010 INTERFACE menu.
PRINTER INTERFACE
SET PREV NEXT
Goes to INTERFACE UNUSED menu.
SELECT PRINTER TYPE
SEIKO TJET 315

9 Electronic Theory of Operation

The electronic theory of operation of the Model 520A Pulse Oximeter monitor is detailed in the subsections below. Refer to Section 19, *Schematic and Assembly Drawings*, on page 83 for further information.

2472 Power Supply Board 9.1

The 2472 Power Supply Board contains the circuitry needed to power the monitor from the AC Mains (line voltage). The power supply board also connects to the battery and contains the battery charging circuitry.

AC Mains and Battery Operation Overview 9.1.1

The Model 520A can be powered from its internal 12 volt battery or from the AC Mains. The green ∿ (sine wave shaped) front panel indicator illuminates when the line cord is connected and the rear panel power switch is in the "|" (On) position. This indicates that AC Mains power is reaching the power supply, that the battery is being charged, and that if the monitor is turned on, it is being powered from the line voltage.

If AC Mains power is removed by unplugging the line cord or setting the rear panel power switch to the "0" (Off) position, the monitor will operate for up to four hours from its internal 12 volt lead-acid battery. As the battery voltage runs low (≈11.5 volts), the red 🔋 (battery indicator) on the front panel illuminates. At this point, the AC Mains should be reconnected to power the monitor and charge the battery.

If the monitor continues to be powered from a battery in a low voltage situation, at approximately 11 volts, a continuous alarm sounds for thirty seconds while the Message Center displays BATTERY EXHAUSTED CONNECT LINE CORD. If this alarm/message is ignored, the monitor displays will shut down and the battery indicator will flash on and off about every 5 seconds. If AC power is now restored, the monitor will re-initialize (go through the power up and self-test routines) and resume normal operation. However, continued battery operation will eventually activate a hardware low voltage circuit (≈8.5 volts) that shuts the monitor off to prevent damage to the battery. Once the unit is shut down with the hardware circuit,

the AC Mains must be connected and the front panel **POWER** key pressed before the monitor will turn back on.

AC Mains Operation 9.1.2

The AC Mains voltage enters the monitor at the rear panel Power Entry Module (PEM). This device contains a built in RFI power line filter, a double-pole single-throw switch that opens and closes both AC input lines, fuses, and an input voltage selection card.

The filtered, switched and fused output of the Power Entry Module is fed to the primary coils of the rear panel mounted system transformer, T301. The secondary output from T301 is rectified by D1 (bridge rectifier) and filtered by C1. The (loaded) DC voltage at this point is approximately 20 volts.

The 20 DC volts is fed to the 2471 main board through fuse F301 to connector E302, and is switched to the battery charging regulator IC1 (pin 5) through Q1. Biasing for Q1 is accomplished by D2, R1 and R2 when AC power is applied. When running on battery power Q1 is biased off by R1, R2 and D3, this prevents the battery from trying to power the battery charger regulator and IC2 that informs the monitor of the loss of AC.

The output of switching regulator IC1 pin4 is rectified and filtered by D4, C4 and L1 then fed to the battery through current sense resistor R3 and fuse F302 to J302 pin 1 (VBAT+). The battery float charge voltage is maintained at 13.2 volts except for fast charge which is regulated at 14.4 volts. The output is also monitored for over current conditions. These parameters are controlled by IC3 and associated circuitry. When the battery charge current exceeds 120mA of current IC3 pin 7 goes high which biases Q2 on, this in turn shorts out R12 which affects the feedback control (FB) to IC1 (pin 1). With R12 shorted out the control resistors R14 and R13 set the output voltage to 14.4 volts. When the charge current lowers IC3 pin 7 goes low which biases Q2 off, this puts R12 back into the feedback control which now consists of R12, R13 and R14 setting the voltage to 13.2 volts. When more than 600mA of current flows through R3, IC3 pin 1 shorts IC1 pin 2 to ground which shuts IC1 off until its next switching cycle, when the current reaches a safe level IC3 pin 1 allows IC1 to remain on.

The voltage switched by Q1 is also fed to IC2 as VCH (Voltage Charge). The output of this 5 volt regulator provides the LINEST (Line Status) signal to the main board at E302 pin 3. With AC applied, LINEST is high. LINEST goes low when the AC is disconnected. The LINEST line is also routed to the power on/off circuitry. See *Power On/Off Control Circuitry* on page 15.

Battery Operation 9.1.3

Without AC power there will be no secondary voltage rectified by D1. Power for the monitor will be supplied from the battery at J302 pins 1 (VBAT+) and 2

(VBAT-). The battery power will conduct through D3 and F301 to VIN at E302 pin 1 to the 2471 main board. The arrangement of R1, R2 and D2 bias Q1 off in this condition which prevents power from reaching IC1, IC2 and IC3. The output of IC1 is also protected by D5 which is now reverse biased, the bridge D1 is also reverse biased and prevents T301 from discharging the battery. With no voltage at IC2 the LINEST will be low which indicates to the main board that there is no AC power.

2471 Main Board 9.2

The 2471 Main Board contains all the analog and digital circuitry that controls the sensor, external communication and front panel display. The isolated power supplies, microprocessor circuits and memory are all contained on this board.

Power On/Off Control Circuitry 9.2.1

The Model 520A power on/off control circuitry consists of the VBACK supply (regulated by IC12), IC10, IC11 and the **POWER** key. (See page 4 of 5 on schematic.)

When the battery or AC Mains is first applied to the power supply board (via VIN J102 pin 1), VBACK goes to +5 volts, provides power to IC10 and IC11, and through the C26 and RP4 (pins 3,4) network at IC10 pin 8, sets IC10 pin 2 to a logic Low.

The ON/OFF line is brought Low each time the front panel **POWER** key is pressed. This sends the output at IC11 pin10 High. This Low-to-High transition clocks the (#1) D flip-flop portion of IC10. The /Q1 output at IC10 pin 2 goes High and with each successive press of the **POWER** key, this output toggles to the opposite level (Low or High). A High turns the Model 520A on and a Low shuts it off.

While the /Q1 output at IC10 pin 2 is High, the MOSFET Q7 is turned on and pulls the gate of MOSFET Q8 to ground, thus causing Q8 to conduct as well. With Q8 conducting, the currently active monitor power source—either the AC Mains derived supply or the battery supply will flow through Q8 to the voltage input (pin 7) of the Pulse Width Modulator IC9. The output IC9 pin 6 will oscillate (at the frequency set by R13 and C15). This causes Q5 to switch on and off and provide a path to ground through the primary coils of T1 for the supply (Mains or battery) at T1 pin 12. Current flowing in the primary is measured at IC9 pin 3 and the duty cycle of the pin 6 output will vary with the load on the transformer.

Current flow in the transformer primary induces current in the three secondary coils and creates the ± 12 volt analog supplies (+V12 and -V12), the VRAWI that powers the isolated RS232 circuitry, and the +5 volt VCC supply that power the remaining circuits in the monitor. The Model 520A turns on. The +V12 and -V12 supplies are rectified and filtered by D2, D4, C10, C11, C12 and C13. The +V12 is regulated by IC7 and the -V12 by IC8. The VDD supply is rectified by D3, filtered by L1, C9 and C20 and fused at F1, and in addition, a feedback loop to IC9 contains VR1

which is factory adjusted to produce a +5.00 volt ± 0.05 volt VCC supply (measured under load).

Once the monitor powers up, a SYNC signal toggles Q9 on and off causing a timing pulse to be transmitted across C19 and C15 to the input at IC9 pin 4. This has the effect of synchronizing the output of the pulse width modulator with the data sampling operations of the analog board and keeps power supply switching spikes from interfering with those operations.

Power Supplies 9.2.2

The secondary pins 7, 8, 9 of T1 form a center tap transformer, the voltage is rectified by D2 and D4 then filtered by C10, C11, C12 and C13. The dual 12 volt supplies, +V12 and -V12 which are generated from this voltage are regulated by IC7 and IC8 respectively. The secondary winding of pins 5 and 6 of T1 are rectified by D3 and filtered by C9, L1 and C20, this voltage designated as VCC (+5 volts) acts as reference for IC9, supplies power for the opto isolator non-isolated side and powers other circuitry on the board.

The secondary winding consisting of pins2 and3 are rectified and filtered by D1 and C1. The rectified voltage at this point is approximately 7 volts DC and is regulated to 5 volts by IC2. This isolated supply powers the isolated portion of the opto-isolators and the RS232 driver chip IC1. The unregulated voltage VRAWI is sent to the rear panel connector J101.

The backup voltage (VBACK) is regulated by IC12 from the VIN supply. Capacitors C22 and C27 serve as filters and D17 allows VCC to power VBACK circuitry when the monitor is on. At this point D18 is biased off so IC12 is idle. When the monitor is turned off and VCC collapses D18 is then forward biased and IC12 now supplies VBACK circuitry, D17 at this time is reverse biased and prevents power from reaching VCC.

The saturation sensor LEDs derive their power (LEDSRC) from the current regulator IC32. (See sheet 2 of 5 on schematic.) Resistor R31 limits the maximum current draw to 45 mA (nominal draw 35 mA). Regulator output is filtered by C85 and L2. The charge stored on capacitor C1 supplies the 290-350 mA peak currents that can occur when the sensor LEDs are turned on. Diode D12 prevents the regulator output from exceeding +7.5 volts while the fuse, F2, provides current limit protection in the event of a regulator circuitry failure. The RP10(pins 1,8 and 5,6) divider network provides the CPU (via IC33) with a means to monitor the LEDSRC status.

The +VA and -V12 supplies are regulated to +V5 (+5 volts) and -V5 (-5 volts) by IC44 and IC43 respectively. These supplies are used by the 20 bit ADCs, the 8 bit ADC and other circuits associated with them.

Voltage References 9.2.3

A +2.5 volt precision reference supply, generated by IC35 from the 12 volt +V12 supply, is used as a reference voltage for the ADC chips IC37 and IC34.

The +2.5 volt output from IC35 pin 6 is fed to the non-inverting input of amplifier IC36 pin 3. Resistors R32 and R33 combine for a gain of 1.617 that provides a +4.096 volt reference (approximately) supply, 4VREF, at IC31 pin 1.

The 4VREF is fed to IC30 pin 13 which is set up as a unity gain inverting buffer amplifier, therefore the output at IC30 pin 14 is -4 volts. This -4 volts is used by IC29 as a reference voltage for VLED (Voltage LED) and CNTRST (Contrast) controls. (See sheet 3 of 5 on schematic.)

Preserving RAM and Real Time Clock Data 9.2.4

The NAND gate output at IC11 pin11 will be Low when the monitor is on (IC10 pin 2 is High) and High when the monitor is off (IC10 pin 2 is Low). (See sheet 4 of 5 on schematic.) This PWRON* (Power On) signal is used to prevent corruption of RAM and clock data when the monitor is turned off. It does this by going High and therefore denying CPU access to the RAM and clock chips so that as the power supplies crash when the monitor is turned off, the CPU cannot send erroneous data to the chips.

Whenever the CPU is writing information to the RAM or Real Time Clock chips, the CPU momentarily sends the OFFDIS (Off Disable) line High. The High going level appears at IC11 pin 2. Since the monitor is powered on, IC11 pin1 will be High. This means IC11 pin3 momentarily goes Low, Q6 starts to conduct and IC10 pin 4 goes High. In this reset condition the /Q1 output #1 flip-flop of IC10 (pin 2) will be held high even if the user presses the **POWER** key and clocks the flip-flop. In effect, the CPU is not allowing the monitor to be turned off. The Low at IC11 pin3 will last for the duration of the RC time constant set by C21 and RP4 (pins 5,6). These values were chosen to produce a time-out longer than the time necessary to complete the write to RAM or Real Time Clock operation. After the RC time-out, IC10 pin 4 returns Low and a press of the **POWER** key will toggle the /Q1 output of IC10 and the monitor will turn off. This is done to prevent corruption of RAM and Real Time Clock data.

Low Battery Voltage Shutdown 9.2.5

The CPU monitors the battery voltage and provides the user with a low battery indicator (🔋), messages and alarms. However, if these are ignored, a hardware circuit will take over and shut off the monitor before the battery is damaged.

The pulse width modulator IC9 requires at least 7.6 volts at pin 7, its voltage supply, in order to operate. This pin typically draws 10 mA of current. The resistance of the R63 and Q8 combination is approximately 114 ohms. This equates to a voltage drop

of approximately1.14 volts. Therefore if the battery voltage drops under 9.0 volts (approximately), IC9 will not have sufficient voltage to operate and will shut down. Shutdown of IC9 stops current flow through transformer T1 and the secondary supplies shut down, effectively turning off the monitor.

When IC9 shuts down, its VREF output at pin 8 is pulled Low. This forward biases D6 and causes the NAND gate output at IC11 pin4 to go High. The #2 flip-flop of IC10 is clocked, and the High at the D2 input (because /Q1 is High) is transferred to the Q2 output at pin 13. The High at pin 13 Sets the #1 flip-flop causing the /Q1 pin 2 output to go Low. This Low shuts off both MOSFETs Q7 and Q8, thereby blocking any supply voltage from IC9 pin 7. Normally, pressing the front panel **POWER** key would clock flip-flop #1 (at pin 3) and return the pin 2 output High—but the High output at pin 13 keeps the #1 flip-flop Set—and the **POWER** key has no effect.

If at this point the AC MAINS is reconnected, MOSFET Q8 continues to block current from IC9 pin 7 and the monitor remains off. Connecting the AC Mains does however send the LINEST signal High. This High Line Status signal is brought to IC10 pin10 where it Resets the #2 flip-flop, sending IC10 pin 13 Low and removing the Set condition from flip-flop #1. Now, if the front panel **POWER** key is pressed, flip-flop #1 is clocked, IC11 pin11 goes High, MOSFETs Q7 and Q8 turn on, the supply to IC9 pin 7 is restored, the pulse width modulator restarts, energizes T1, and the monitor turns back on.

Timing Sequencer 9.2.6

A 14 stage divider, IC39, acts as a timing sequencer. (See sheet 2 of 5 on schematic.) A 3.276 MHz crystal Y2, provides a Clock Sequence (CLKSEQ) to IC39 pin 10. The IC39 pin 11 RESET input line resets IC39 on monitor power up.

The IC39 pin 9 Q1,output provides a clock input signal to the audio tone generator IC27. The IC39 pin 3 Q14 output provides a 5 ms interrupt (INT5MS) for IC18. The Q4-Q11 outputs of IC39 become inputs to the Data Sampling Controller IC42.

Data Sampling Controller 9.2.7

The IC39 Timing Sequencer's Q4-Q11 outputs become inputs to IC42, a PEEL (Programmable Electrically Erasable Logic) device. The PEEL uses the CLK and D0-D6 inputs, and the SC1 and SC2 inputs, to control data sampling by providing sensor LED drive signals and demultiplexing for the signals returning from the saturation sensor.

The waveforms in Figure 3.(with the exception of CLK) are only valid when both the SC1 and SC2 inputs are low. The System Calibration inputs (SC1 and SC2) generated by the microprocessor, are kept low, except that they are toggled high/

low, during a Probe Off Patient alert, and during a system power up self-test. See *Calibrating the 20-Bit Analog-to-Digital Convertors* on page 21.

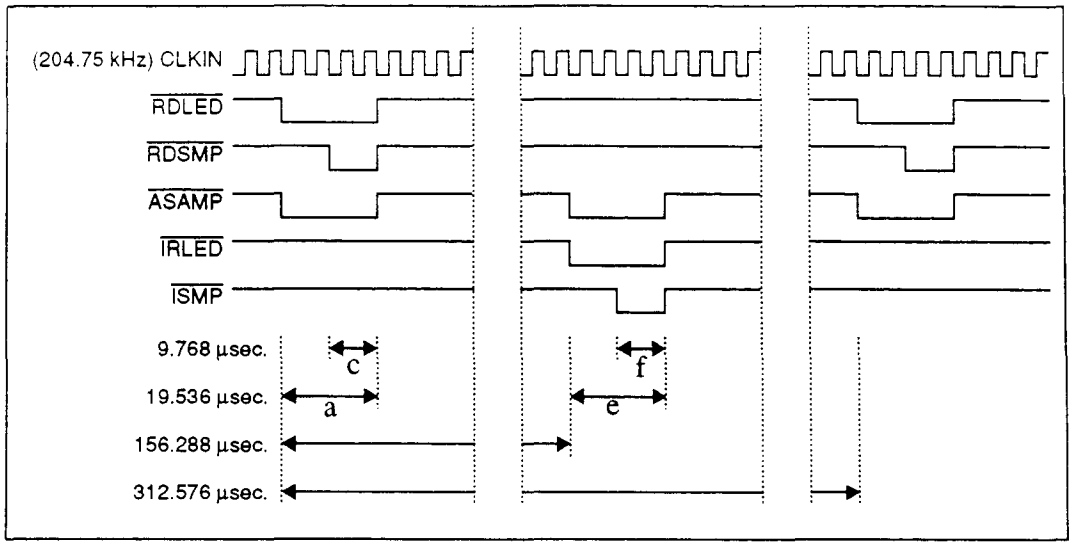


Figure 3. Data Sampling Timing

The data sampling sequence consists of,

a. turn on the Red LED (RDLED*) and the Analog Sample line (ASAMP*)
b. allow the Red LED time to reach full brightness (steady state light output)
c. sample the Red LED return signal (RDSMP*)
d. turn off the Red LED, the Analog Sample line, and stop sampling
e. turn on the Infrared LED (IRLED*) and the Analog Sample line (ASAMP*)
f. allow the Infrared LED time to reach full brightness (steady state light output)
g. sample the Infrared LED return signal (ISMP*)
h. turn off the Infrared LED, the Analog Sample line, and stop sampling
i. repeat the process starting at step a.

The Analog Sample (ASAMP*) line is used to nullify the effects of any ambient light signals returning from the sensor. See *Sensor Photodiode Return Path* on page 20.

The IC42 INSIG* and SIGND* outputs are used in conjunction with the SC1 and SC2 inputs. See *Calibrating the 20-Bit Analog-to-Digital Convertors* on page 21.

The IC42 pin 14 external sequencer (SYNC) line is equivalent to the PEEL's D1 input. It provides a "sync" pulse to the pulse width modulator on the power supply board in order to keep power supply switching spikes from interfering with data sampling operations.

Sensor LED Drive Circuits 9.2.8

The VLED line voltage is derived from IC30 pin 8 which is controlled by the Digital to Analog Converter IC29. (See sheet 3 of 5 on schematic.) When address line A0 is high (IC29 pin 6) and both WR* (IC29 pin 16) and DACCS* (IC29 pin

15) are low the D/A Converter is enabled. The data on lines D0-D7 (IC30 pins 14-7) now control the output voltage of IC30 pin 8 (VLED) based on the VREFB voltage on IC29 pin 18.

When the RDLED* signal at IC42 pin 18 goes low (logic 0), Q14 turns off and the Red LED signal (VLED from IC30 pin 8) at R37 is divided by R37 and R41, finally causing IC36 pin8 to go high. This positive output turns Q11 on and current flows from the LED source (LEDSRC), through the Red LED in the sensor (it turns on) returning as LED1SK (LED1 sink) across Q11 and the current limiting resistor R53 to ground. (See sheet 2 of 5 on schematic.)

When RDLED* returns high (logic 1), Q14 is biased on, forcing IC36 pin8 to ground potential: Q11 is biased off, and as a result, the Red LED in the sensor is also off.

The Infrared LED drive circuit operates in the same manner as the Red LED drive discussed above. The IRLED* signal at IC42 pin 17 activates Q13 the LED2S signal causes a positive signal at IC36 pin 14, and current can flow from the LEDSRC supply through the sensor's Infrared LED, Q12, and the current limiting R52 to ground.

Sensor Photodiode Return Path 9.2.9

Light, from the sensor's Red or Infrared LED, shines through the pulsating vascular bed (the patient's finger, toe, etc.) placed between the LEDs and the photodiode. Some of this light emerges from the tissue and impinges on the photodiode, causing the photodiode to conduct current. IC40 pins 1-3 is set up as a differential amplifier that converts this input current to a voltage at the amplifier output. The sensors are wired such that photodiode current produces a positive voltage at IC40 pin 1[1].

The voltage at IC40 pin 1 is presented to an analog switch IC41 pin 6. This switch is controlled at pin8 by INSIG* (Input Signal) from IC42, and will be closed (IC41 pins6 and7 connected) except if the monitor is in a Probe Off Patient condition or is undergoing its Self-Test at system power up. The switch IC41 pins 9-11, controlled from SIGND* (Signal Ground) at IC42 will be open (no connection between IC41 pins10 and 11) except as noted above for the switch at IC41 pins 6-8. As a result, the IC40 pin 1 voltage passes undisturbed to the high pass filter consisting of R59 and C90.

As shown in Figure 3., the ASAMP* signal is active whenever either sensor LED is turned on. This causes Q15 to turn off and the charge at C90 passes through the unity gain buffer to IC40 pin 7.

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1. The Model 520A uses SuperBright™ sensors (part number 87xx series). If a non-SuperBright™ (Novametrix part number 86xx series) sensor is connected, IC40 pin 1 will go negative—a condition that causes an "Incompatible Probe" message to be displayed.

If the signal at IC40 pin 7 is the product of the Red LED being turned on, then RDSMP* from IC42 pin 12 will go low and close the switch at IC41 pins 2-3, thereby presenting the signal to a sample and hold circuit consisting of R54 and C100 (that maintains the signal until next sample pulse arrives), a gain stage, (IC38 pin 1), a filter/divider network (C87, R45 and R46), and finally, to the Red channel Analog-to-Digital Convertor (ADC) IC34.

If the signal at IC40 pin 7 is the product of the Infrared LED being turned on, then ISMP* from IC42 pin 13 will go low and close the switch at IC41 pins 14-15, thereby presenting the signal to a sample and hold circuit consisting of R55 and C96 (that maintains the signal until next sample pulse arrives), a gain stage, (IC38 pin 7), a filter/divider network (C88, R49 and R50), and finally, to the Infrared channel Analog-to-Digital Convertor IC37.

Again referencing Figure 3., the ASAMP* line returns to a logic high when neither LED is being driven, causing Q15 to turn on. With Q15 conducting, any charge at C90 is discharged to ground and the next pulse will charge C90 from a known level. If it were not for Q15, any charge remaining on C90 from the previous pulse or from ambient light reaching the photodiode would be added to the charge from a new pulse—creating measurement errors.

Calibrating the 20-Bit Analog-to-Digital Convertors 9.2.10

The 20-bit ADCs are calibrated as part of the system self-test which occurs each time the monitor is turned on. At power up, the microprocessor sets the CAL line high. The System Calibrations input SC1 is set high and SC2 is reset to a logic low. The CS5503 ADC will not operate while the CAL line is high. On the falling edge of the CAL signal, the ADC will initiate a calibration cycle determined by the state of the SC1 and SC2 inputs.

The high at SC1 and the low at SC2 cause the Data Sampling Controller, IC42, to set INSIG* high and reset SIGND* to a logic low. The high INSIG* opens the switch at IC41 pin8 so that IC41 pins 6 and 7 are no longer connected—disconnecting the returning photodiode signal from the rest of the circuitry. The low SIGND* signal closes the switch at IC41 pin9 and as a result, the input to the C90-R59 high pass filter (and thus the entire ADC input circuitry) is brought to ground potential.

The CAL line (which went high at power up) is reset low and ADCs IC34 and IC37 begin their calibration cycles. Because the analog input circuitry is grounded via SIGND*, only circuit offset voltages can be present at the (pin 9 AIN) input. The calibration cycle sets the ADC "zero" point to equal this voltage, thus compensating for any circuitry offsets. The ADC then sets its "full scale" point to equal the voltage at its VREF (pin 10) input. This completes the calibration cycle.

The ADC can now start sampling its input and converting it to a 20-bit digital word. The processor resets SC1 to a logic low, causing IC41 pin9 to open and IC41 pin8

to close. The photodiode signal can now reach the ADCs. See *Sensor Photodiode Return Path* on page 20.

20-Bit Analog-to-Digital Conversion 9.2.11

Data from the Red and Infrared channels is sampled by the 20-bit measurement ADCs, IC34 and IC37 respectively. The analog input at pin 9 is converted to a digital representation with 20-bit resolution based on the input magnitude.

The CS5503 convertor continuously samples its input, converts the value to a digital word, puts the word in its output buffer (overwriting previous buffer contents), then repeats the process by again sampling its input. The frequency of the sample/convert/overwrite-buffer sequence is based on the 3.2768 MHz clock signal at the ADC pin 3 (CLKSEQ) input.

The microprocessor starts a read cycle of the Infrared channel by bringing IC37 pin 16 (Chip Select Channel 1) low. A Red channel read starts when IC34 pin 16 (Chip Select Channel 2) is brought low.

On the falling edge of the ADC's CS*, the output word's MSB (most significant bit) appears at the pin-20 SDATA (Serial Data) output. The SDATA line connects directly to the microprocessor's serial input (RXS) pin. The remaining bits (in descending order) are output from SDATA with subsequent falling edges of the Serial Clock (SCLK) input at pin 19. The SDATA output automatically goes to a 3-state (high impedance) condition after completing a word transmission, thus freeing the data line for other uses (i.e., the other ADC channel).

The Serial Clock speed is controlled through the digital board PEEL IC18. This clock rate is significantly slower than the ADC sampling rate. As a result, the ADC rewrites its output buffer with new information at a faster rate than the data can be read from the buffer. No conflict occurs, however, because while CS* is low (during the read cycle), the ADC does not update its output buffer—the current word is not overwritten. After the processor receives the entire word, it allows the convertor's CS* to return high, and the ADC resumes its sample/convert/overwrite-buffer cycle.

Sensor Status Decoding and Conversion 9.2.12

The microprocessor monitors several sensor parameters in addition to the Red and Infrared data channels. It monitors the status parameters, as well as the voltage of the monitor's internal battery.

The 8-to-1 multiplexor, IC33, decodes the A0AUX-A2AUX input address lines and connects one of eight status parameter inputs (labeled channels 0-7 at IC33) to the multiplexor output at IC33 pin 3. Resistor R29 and diode D13 prevent negative voltages from reaching the input to the analog-to-digital convertor, IC31.

IC31 is an 8-bit analog-to-digital convertor with a serial data output. While the IC31 Chip Select ($\overline{CS}$) input is high, the CLK input and DOUT output are in 3-state mode. When $\overline{CS}$ is brought low (under processor control), the most significant bit (D7) of the *PREVIOUS* data conversion becomes available at the DOUT pin. The remaining bits (D6-D0) are shifted out on subsequent falling edges of the CLK input. On the clock pulse following the one that shifts out the least significant bit (D0), the CLK and DOUT lines are returned to 3-state and the ADC performs a new conversion based on the input it receives from the IC33 channel selected by the A0AUX-A2AUX input address lines.

The ADC sample/convert/store-result cycle is based on internal chip timing and not the CLK input which (along with $\overline{CS}$) only controls serial data output. Thus the $\overline{CS}$ line is free to return high once the ADC cycle begins.

Sensor Status Parameters 9.2.13

The sensor (and battery) status parameters input to the multiplexor IC33 are described below. Note that channel number refers not to the IC33 pin number, but to the signal label (e.g., channel I0 signal resides at IC33 pin 13).

Channel I0: ADCV12.
This is an extra input to the multiplexer IC33 pin 13. It is unused as of this writing.

Channel I1: Auxiliary Input.
This is an extra input to the multiplexer IC33 pin 14. It is unused as of this writing.

Channel I2: Photodiode DC Level.
Resistors R40, RP8 (pins 1, 2) and capacitor C97 form a voltage divider and low pass filter that provide a measure of the mean DC level at the output of the photodiode current-to-voltage amplifier IC40 pin 1. This channel (IC33 pin 15) is used in determining ambient light interference. If this line is examined while the sensor's Red and Infrared LEDs are turned off, then any DC level at IC40 pin 1 must be the result of ambient light impinging on the photodiode. If the DC shift is in excess of limits set in the software, a Light Interference message appears on the monitor's display.

Channel I3: Sensor LED Supply Voltage.
This channel, at IC33 pin 12, monitors the sensor LED supply voltage through a voltage divider consisting of RP10 (pins 5, 6) and RP8 (pins 1, 8). If a fault occurs that causes the LED supply fuse F2 to blow, or if the sensor wires are shorted, this channel reports the condition and the Message Center displays PROBE FAILURE.

Channel I4: Incompatible Probe Detection
The input at IC33 pin 1 provides the processor with an incompatible probe indicator (words probe and sensor are interchangeable). The photodiode output voltage at IC40 pin 1 will be positive if a SuperBright™ 8700 series sensor is connected to the monitor. (The correct sensor family used with the Model 520A all have part numbers in the form of 87xx) This positive signal passes through the high pass filter

of C73 and RP10 (pins 7, 8) to the amplifier inverting input IC36 pin 6, where it is summed with the -5 volt output from IC43. The resultant voltage at IC33 pin 1 will be approximately +2.81 volts with no photodiode input. This voltage drops as the (positive) photodiode signal at IC40 pin 1 increases. If the IC40 pin 1 signal goes negative, as would happen if a non-SuperBright™ 8600 series sensor were connected to the monitor, the cumulative effect of the -5 volts and the negative photodiode signal passing through D14 and R34 would be to send the IC36 pin7 output to its positive rail (+12 volts). The processor recognizes this higher voltage and causes an INCOMPATIBLE PROBE message to displayed in the Message Center.

Channel I5: Infrared LED Cathode Voltage.
A low pass filter consisting of RP10 (pins 3, 4), RP8 (pins 1, 7) and C89 provides a means to measure the cathode voltage of the sensor's Infrared LED. If the channel at IC33 pin 5 is sampled the monitor can determine if the LED is open circuit (zero volts at IC33 pin 5) or operational (approximately 2.5 volts at IC33 pin 5). If not operational, display messages such as PROBE I.R. LED FAILED or ERROR - FAULTY PROBE are generated.

Channel I6: Battery Supply Voltage
The monitor's internal battery voltage is divided down by RP3 (pins 7, 8) and RP8 (pins 1, 5). The voltage at IC33 pin 2 is monitored and if its magnitude is less than a predetermined value (encoded in the software) the monitor lights and/or flashes its front panel battery indicator. This provides the user with a low battery warning.

Channel I7: Red LED Cathode Voltage.
A low pass filter consisting of RP10 (pins 1, 2), RP8 (pins 1, 8), and C92 provides a means to measure the cathode voltage of the sensor's Red LED. If the channel at IC33 pin 4 is sampled the monitor can determine if the LED is open circuit (zero volts at IC33 pin 4) or operational (approximately 2.5 volts at IC33 pin 4). If not operational, display messages such as PROBE RED LED FAILED or ERROR - FAULTY PROBE are generated.

Microprocessor 9.2.14

A Hitachi HD64180RP microprocessor directs the actions of the Model 520A Pulse Oximeter. (See sheet 1 of 5 on schematic.) The processor, IC16, is operated at 6.144 MHz (half the12.288 MHz frequency of crystal Y1), has an 8-bit data bus and a 19-bit address bus (the 520A uses only 18-bits). The microprocessor also provides two asynchronous serial communication channels, a clocked serial I/O port and various interrupt and control signals. The +5 volt VCC supply to the processor is first sent through inductor FB1, a ferrite bead, before powering the chip at IC16 pin 32.

Memory 9.2.15

The Model 520A system software is located at IC17, a 27C010 EPROM. The 32 K byte RAM, IC20, stores trend data, system power up settings (averaging times,

serial output parameters, etc.), and provides an area for system (scratchpad) memory requirements. Since IC20 is powered from the VBACK supply, RAM memory is retained when the monitor is turned off and it becomes available again when the monitor is turned back on.

The ROM at IC17 is read when its Chip Enable line (IC17 pin 22) is brought low by the ROMCS* signal at IC25 pin 3, and the processor brings its Read line (IC16 pin 63) low—thereby activating the ROM Output Enable line at IC17 pin 24. Under these conditions, ROM data from the specified address bus location is made available to the data bus for use by the processor.

The RAM (IC20) is activated when its Chip Select line RAMCS* (IC20 pin 20) is brought low, via IC25 pin 8. When the ME* line at IC25 pin 5 is low, and the inverse of address line A17 at IC25 pin 4 is low, output pin 6 of IC25 will go low. This in turn will drive IC25 pin 10 low, with PWRON* low at IC25 pin 9, IC25 pin 8 will be low (RAMCS*). If at that time, $\overline{OE}$ (IC20 pin 22) is low, a RAM Read occurs, whereas a RAM Write will occur if $\overline{WE}$ (IC20 pin 27) is low.

Real Time Clock (RTC) 9.2.16

A Real Time Clock provides the Model 520A the ability to time stamp collected (printed) trend data. (See sheet 3 of 5 on schematic.) The 32.768 kHz crystal, Y3, provides the timing signals for the clock chip, IC24, which is powered from the VBACK supply so that the clock can continue to keep time when the monitor is turned off (provided the monitor's 12 volt internal battery is connected and maintains at least a nominal charge).

The RTC is activated when its Chip Select line (CS0*) at IC24 pin 2 is brought low. With the monitor on PWRON* will be low (IC25 pin 13), the RTC* line will be brought low by the processor through IC22 pin 14, these lines drive RTCCS (Real Time Clock Chip Select IC25 pin 11) low. If at this time, the RD* (IC24 pin 8) input is low, a RTC Read occurs, whereas a RTC Write will occur if the WR* (IC24 pin 10) input is low. Addressing is handled by A0-A3 (pins 4-7) and data I/O through D0-D3 (pins 14-11).

Sound generator 9.2.17

A programmable tone generator, IC27, is used to drive the monitor's audio circuit. The tone generator is clocked by IC39 pin9 from the 1.638 MHz signal, Q1. The tone generator is enabled by the processor when IC22 pin12 is brought low. While CE* is low, WR* is brought low and data bus information including frequency (pitch) and attenuation (volume) is accepted by the tone generator. The Ready signal (IC27 pin 4) goes low while accepting data and the processor is put into a Wait state until IC27 finishes its task; then Ready returns high and the processor continues its operations.

The AUDOUT output at IC27 pin 7 drives the audio amplifier IC26. The amplifier output is coupled through capacitors C55 and brought to J109 as the SNDOUT (Sound Out) line. The speaker which is mounted in the chassis is connected to J109, LS1 is not installed on the 2471 Main Board.

Keypanel Interface 9.2.18

The12 keys (switches) on the Model 520A front panel are connected to the 2471 Main Board through a ribbon cable at J104. Each key (except **POWER**) is connected to an 8-bit latch (either IC14 or IC15). When any of these keys is pressed, the corresponding latch input is brought low. The processor continually reads the status of these latch outputs, the RDKEY* enables IC14 when low and the RDKEY_2* line enables IC15 when brought low.

The **POWER** key ON/OFF signal is sent through J104 pin 15. The AC Line Status signal, LINEST, is generated by the power supply, and is high (+5 volts) when the monitor is connected to the AC Line (Mains) and the rear panel switch is set to "|". This +5 volt level is sent to LED D2 (the green ∿ indicator) on the keypanel via J104 pin 16. The LINEST signal is also input to the latch at IC14 pin 8 so that the CPU can detect if the unit is operating on AC line power (IC14 pin 8 high) or on battery power (IC14 pin 8 low). Diode D9 keeps current from backfeeding into IC14 when the monitor is turned off but still connected to the AC line.

The 2MIN (D3), AUDIO OFF (D4), ALERT (D5), and LOW BAT (D1) LEDs are driven by the 8-bit latch IC13. When each of the corresponding signals is driven high the appropriate LED on the keypanel is illuminated. See *I/O Device Controller* on page 27.

Display Interface 9.2.19

The display is connected to the 2471 Main Board at J107. It is controlled by the processor using the RD* (Read), WR* (Write), and DISPCS* (Display Chip Select) lines. Data bits D0-D7 are used as input/output lines and A0 is used in conjunction with the RD* and WR* lines to distinguish between read and write operations as listed below.

A0	RD* Low	WR* Low
High	Status Read	Command Write
Low	Data Read	Data Write

Table 1. Display Command/Data table.

The CNTRST (Contrast) line is controlled by pressing the front panel ◐ key. When depressed and held the processor controls the digital to analog converter IC29, line A0 is brought low along with WR* and DACCS*, the data on D0-D7 controls the voltage at IC30 pin 7 which can vary from 0-4 volts. The output of IC30 pin 7, along

with 4VREF feeds a summing amplifier (IC30 pins 1, 2, 3). The output of the summing amplifier IC30 pin 3 controls the base of Q10 which in turn controls the contrast of the display through a variable negative voltage.

The backlight for the display is controlled by the DSPBR (Display Bright) line. When DSPBR is high the gate of Q16 is biased off, current flows from Vcc through R51 to IC45. This sets the backlight for low illumination. The illumination of the backlight is made greater when DSPBR is made low, this biases Q16 on which essentially shorts out R51 allowing more current to flow into IC45 creating a full backlight.

I/O Device Controller 9.2.20

The A/D Converter Chip Selects, serial A/D Chip Selects, Sensor Status Decoding and NEXT* line are all controlled by IC28 when selected by the OPORT line (IC21 pin 10). The OPORT line will go high when the L1* and WR* line both go low at IC23 pins 13 and 12, this will send output pin IC23 pin 11 low which drives inverter IC21 pin 10 high enabling IC28.

A 3 to 8 decoder is used to control the DACCS*, RTC*, DISPC*, AUD*, KEYS*, L1*, L2*, 2KEYS* lines. when the IOE* line goes low and the LIR* line goes high being inverted by IC21 pin 2 and presented to IC22 pin 5 as a low enable line IC22 is enabled, Q0-Q7 will be driven low depending upon the A4, A5 and A6 lines on pins 1, 2, 3 respectively on IC22.

With the LPORT line high IC13 is enabled, this latches the data on lines D0-D7 (1D-8D pins 2-9) on its output pins 19-12 (1Q-8Q respectively), the outputs correspond to the following eight lines:
CAL-used by the A/D Convertors on power up to compensate for front end voltage offsets.
TML-Two Minute LED drives the ⏲ LED on the front display.
AOL-Audio Out LED drives the 🔇 LED on the front panel.
ARL-Alert LED drives the 🔔 LED on the front panel.
KJL*-drives Q17 when high which in turn drives the Alert Bar LEDs via J105.
BTL-Battery Low 🖃 LED on the front panel.
DSPBR-(not used on the 520A)
OFFDIS-sent to the Power On/Off section of the circuitry to prevent the monitor from being turned off while writing to RAM.

Watchdog Timer 9.2.21

The Watchdog Timer provides a system reset function in the event a hardware or software "glitch" occurs. The PEEL IC18 forms the heart of the Watchdog circuit. (See sheet 1 of 5 on schematic.)

At powerup and at specific intervals thereafter, the microprocessor outputs a logic high to IC18 pin 8, WDOG (Watchdog). The WDOG signal combines with other

signals within the PEEL and as a result the Watchdog Clear (WDCLR) open drain output at IC18 pin 12 is continually brought low. This discharges the capacitor C46 before it can charge up (via RP2 pins 1 and 2) past the input threshold of IC21 pin 9.

If the WDOG pulse does not appear at regular intervals, as the result of a software or hardware problem, the RC charges up and IC21 pin 8 goes low producing a Watchdog Time-out (WDTO*) input at IC18 pin 11. WDTO* combines with other signals within the PEEL and causes the open drain Master Reset (MR) output at IC18 pin 13 to be brought low.

A low MR causes C45 to discharge, forcing IC21 pin6 high. This sends a reset pulse to the system. It also sets the Reset Input (RESIN) signal at IC18 pin 9 high which causes RESET* at IC18 pin 19 to activate low. The active RESET line causes the microprocessor (IC16 pin 7) and the display module to be reset. The monitor then performs its powerup self-test routines, and if the "glitch" has been cleared, the monitor resumes normal operation. If the problem still exists, a self-test or other error should be displayed.

Serial I/O Controller 9.2.22

Digital data from the three Analog-To-Digital Convertors is read by the CPU through its clocked serial data input (RXS) at IC16 pin 52. The PEEL IC18 acts as the Clocked Serial I/O (CSI/O) Controller.

Except during powerup or Watchdog Timer reset,IC39 pin 3 provides an interrupt to the CSI/O controller in the form of a 5 millisecond period square-wave input to IC18 pin 7 (INT5MS).

On the rising edge of INT5MS, a CPU interrupt request is generated when IC18 pin 18 (CPUINIT*) goes low. The CPU responds by sending the clock input to CSI/O controller (CKS) at IC18 pin 6 low. (This CKS line is inactive high unless a serial receive operation is in progress.) The CPU also sets up the ADC decode lines AA1 and AA0 at IC18 pins 5 and 4, and as a result, one of the ADC chip select lines (CSADC1*, CSADC2*, CSADC3*) is brought low, and the CPUINIT* line is disabled.

On the rising CKS signal a CLKS output pulse at IC18 pin 14 is sent as a serial clock input to the ADC selected by the decode lines. Decode results are shown below.

AA1	AA0	Decode
0	0	Red LED 20-bit ADC
0	1	Infrared LED 20-bit ADC
1	1	Sensor Status 8-bit ADC
1	0	Internal CSI/O signal (TEND)

Table 2. CSI/O Decode Lines

Successive CKS/CLKS pulses cause the ADC data to be shifted out of the ADC (most significant bit first) along the serial data line (SDATA) to the CPU serial input (RXS) at IC16 pin 52.

After receiving the correct number of bits for the ADC being read, the CPU changes the AA1 and AA0 decode lines and exerts the Next line (NEXT*) at IC18 pin 9 low. This restarts the serial data shifting out of the newly selected ADC.

After all three ADCs have been read, the CPU sets the AA1 and AA0 decode lines to exert the internal TEND signal and set the 8-bit ADC to the next channel (so that it has time to settle before the next read of the ADC). This re-enables the CPUINIT line. At this point the CSI/O controller is reset awaiting an INT5MS pulse to begin the cycle again.

RS232 Serial Communication 9.2.23

The Model 520A supports serial (RS232) communication with external devices via the monitor's rear panel connector. Signals to and from the rear panel RS232 connector are electrically isolated from the rest of the Model 520A electronics by four opto-isolators (IC3-IC6). (See sheet 4 of 5 on schematic.)

An isolated secondary coil from transformer T1 is rectified and filtered by D1 and C1 before being input to the +5 volt regulator IC2. The regulated output of IC2 is sent to pin 25 of the 25-pin D connector on the rear panel in order to power the optional Analog Module or Telemetry transmitter. The supply also powers IC1.

The Dual RS232 Transmitter/Receiver, IC1, uses a single +5 volt supply (pin 16). The two Receive (Rx) inputs can accept ±30 volt levels, while the two Transmit (Tx) lines output ±9 volt levels. The four level translators within the chip turn the RS232 level signals to 5 volt TTL/CMOS compatible levels.

Two signals lines TX0 and TX1 transmit data from the CPU across the opto-isolators ICs 3 and 4 to IC1. Here the signals are level shifted to the standard ±9 volt levels and sent to the rear panel connector.

When the CPU brings the TX0 signal at R62 Low, the LED portion of IC3 becomes forward biased and illuminates and causes the transistor portion of the device to conduct. Therefore, when TX0 is Low, IC1 pin 11 is Low and when TX0 is High, IC1 pin 11 is also High. All four opto-isolators work in the same way. IC1 level shifts its input at pin 11 and outputs RS232 standard ±9 volt levels at the TX signal at J101 pin 3. This transmit signal is used to output data to RS232 devices including the Hewlett-Packard ThinkJet Printer and the Novametrix Model 315 Printer.

The CPU TX1 signal crosses the isolation barrier at IC4. The 0-5 volt opto-isolator output at IC4 pin 5 is used to bring data to the Optional 9622-01 Analog Module. The IC4 pin 5 output is also brought to IC1 pin 10. The level shifted output at IC1 pin 7 is unused (except for factory test use).

The Receive (RX) line at J101 pin 2 and the Clear To Send (CTS) line at J101 pin 6 are input signals to the Model 520A. They are level shifted by IC1 and sent across the isolation barrier by ICs5 and 6 respectively.

The transmit signal TX1, is dedicated to communication with the Optional Analog Module (Catalog Number 9622-01) which when connected to the rear panel connector, provides analog representations of the SpO_2 and Pulse Rate values, a plethysmogram signal, and a pass through port for the RS232 connector.

The transmit output TX0 from the CPU and the Receive (RX0) and Clear To Send (CTS*) inputs to the CPU are connected to the rear panel RS232 connector.

10 Maintenance

General 10.1

This section presents recommended maintenance schedules for the Model 520A and information on general maintenance, such as battery and fuse replacement, disassembly and assembly instructions, and system software updates.

Maintenance Schedules 10.2

The electronic circuits within the Novametrix Model 520A Pulse Oximeter monitor do not require scheduled calibration or service. However, in order to maximize battery life, the monitor's internal battery should be exercised monthly. Novametrix recommends the following maintenance schedules.[1]

- Cleaning and Sterilization:
  Perform as required. See *Cleaning and Sterilization* on page 32.
- Battery Life and Maintenance:
  See *Battery Life and Maintenance* on page 32.
- Functional Test:
  Perform on each Model 520A and sensor before being placed in the clinical environment. The test may also be used as a "spot check" to verify system operation if reports of malfunctions are received. The test verifies overall functional integrity of the monitor and sensors. Section 13.2, *Monitor Functional Test*, on page 43
- Accuracy Test:
  This test, which requires the use of the Model TB500B Sensor Simulator, verifies the performance accuracy of the Model 520A. This test is typically performed in conjunction with (after) the Monitor Functional Test. If the monitor does not pass the accuracy test, the Calibration and Adjustment test should be performed. See Section 13, *Accuracy Test*, on page 47.
- Calibration Tests:
  These tests contain information on calibrating the electronic circuits within the Model 520A and should only be performed if the monitor fails to pass the Functional and/or Accuracy Tests. Only qualified service personnel should attempt to perform the Calibration and Adjustment Test. See Section 14, *Calibration Tests*, on page 51.

1. At the customer's request, Novametrix will provide repair and calibration services under the terms of a Service Contract. Contact the Novametrix Service Department for contract details.

Cleaning and Sterilization 10.3

Model 520A Monitor 10.3.1

- Turn the monitor off and unplug from the AC (Mains) line before cleaning.
- Clean the monitor surface with a damp cloth.
- Do not immerse the monitor.
- Do not attempt to sterilize the monitor.

Finger Sensor 10.3.2

- Clean the sensor surface with a damp cloth.
- Ensure the sensor windows are clean and dry.
- Do not immerse the sensor.
- Do not attempt to sterilize the sensor.

Y-SENSOR™ and Y-STRIP™ Taping System 10.3.3

- The Y-SENSOR may be immersed (up to the connector) in a cold liquid sterilant (i.e., Cidex™). Refer to sterilant manufacturer's instructions and standard hospital protocol.
- Rinse thoroughly with water and dry before use.
- Do not immerse Y-SENSOR connector.
- Treat Y-STRIP Taping System in accordance with hospital protocol for single-patient use.

Battery Life and Maintenance 10.4

The monitor was shipped from the factory with a fully charged battery. Since the monitor draws some battery power even while turned off, it is recommended that the monitor be operated on line power for the first 24 hours to allow ample time for the battery to fully recharge.

The monitor may be operated on line power while the battery is recharging. Approximately 16 hours are required to fully recharge a discharged battery.

During prolonged periods of storage or shipment, the battery may discharge enough to prevent the unit from turning on while operated from battery power. If this occurs, plug in the line cord, set the switch on the rear panel to the "I" On position, ensure that the green ∿ indicator on the front panel is illuminated, and allow the monitor to charge for 24 hours before switching it on.

AC Mains 10.5

The Model 520A will operate on line voltages of 100, 120, 220 or 240 VAC ± 10% at 50/60 Hz. At 100/120 VAC,two 0.5 Amp, 250 Volt, Slo-Blo (time delay) AC Mains fuses are required, while Two T 250 mA, 250 Volt fuses are required when operating at 220 or 240 VAC. For continued protection against fire hazard, replace only with fuse(s) of the same type and rating. The rear panel Power Entry Module (PEM) houses the AC Mains fuses and is where the input voltage is selected. It also houses the AC Mains Power switch: set to "I", AC Mains power is presented to the internal circuitry; set to the "0" position, power does not pass through the PEM.

Replacing the AC Mains Fuse(s) 10.5.1

1. Turn off the Model 520A. Set the rear panel AC Mains power switch to "0" and disconnect the line cord from the monitor.
2. Place a screwdriver into the Fuse Access Slot and pry open the Fuse Access Door.

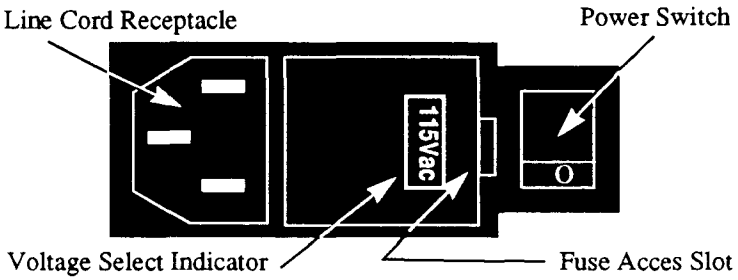

Figure 4. Power Entry Fuse Access Door Opening

3. With the Fuse Access Door open pull the fuse(s) out by pulling on the point of the arrow indicator, the fuse holder assembly will slide out.

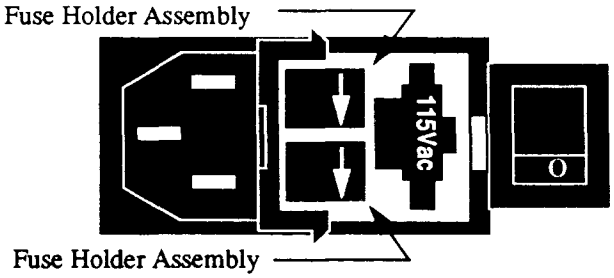

Figure 5. Fuse Removal

4. After replacing the fuse(s), snap the fuseholder assemblies into the PEM and shut the Fuse Access Door.

Changing the AC Mains Voltage 10.5.2

1. Turn off the Model 520A. Set the rear panel AC Mains power switch to "0" and disconnect the line cord from the monitor.

2. Place a screwdriver into the Fuse Access Slot and pry open the Fuse Access Door.
3. Using needle-nosed pliers, pull the Voltage Selector Drum from the PEM. Note the orientation of the drum; the proper voltage should face out.

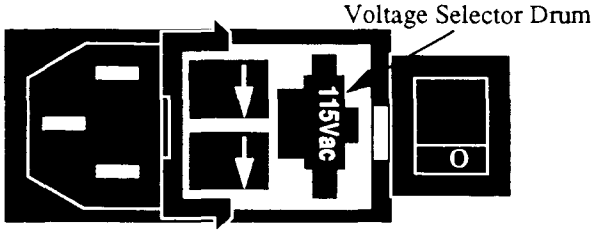

Figure 6. Power Entry Module Voltage Selector Drum Removal

4. Set the Voltage Selector Drum so that the printed side of the correct voltage faces you. The voltage selections are pictured below.

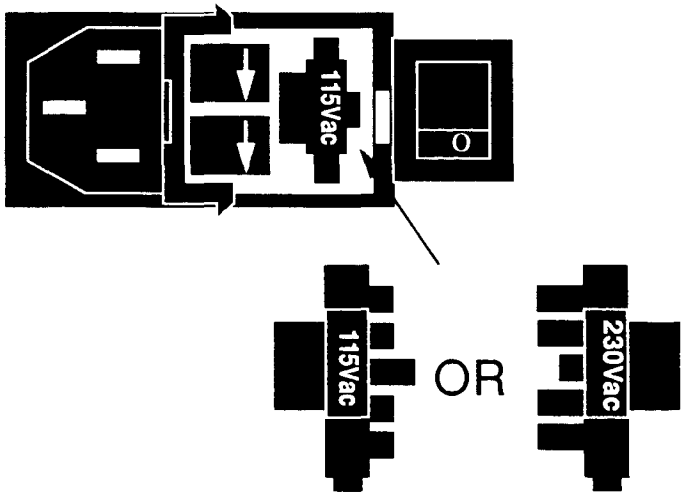

Figure 7. Power Entry Module Voltage Selection Adjustment

5. Snap the Voltage Selector Drum back into the PEM. Be sure that the Voltage Setting Indicator shows the proper voltage. Close the Fuse Access Door.

Assembly Exchanges 10.6

Disassembly should be performed by qualified personnel. Follow proper grounding procedures to avoid damage to internal components from static discharge.

6. Turn the Model 520A Off. Disconnect the line cord and sensor. Remove the four cover screws from the bottom cover. Holding both case halves together, flip the monitor right-side up.

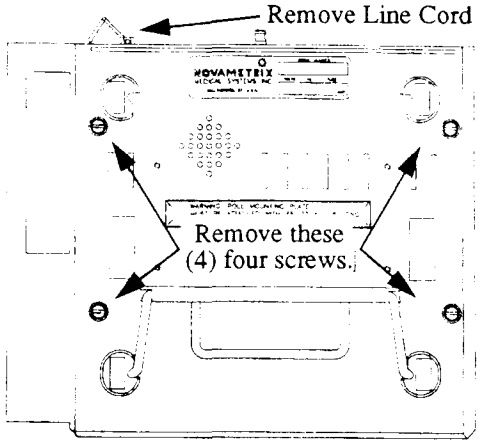

Figure 8. Removing the Top Cover

7. Lift the top cover from the monitor. Use a gentle rocking motion to lift first one side and then the other side a little at a time. Set the Red Alert Bar lens aside with the cover for safe keeping.

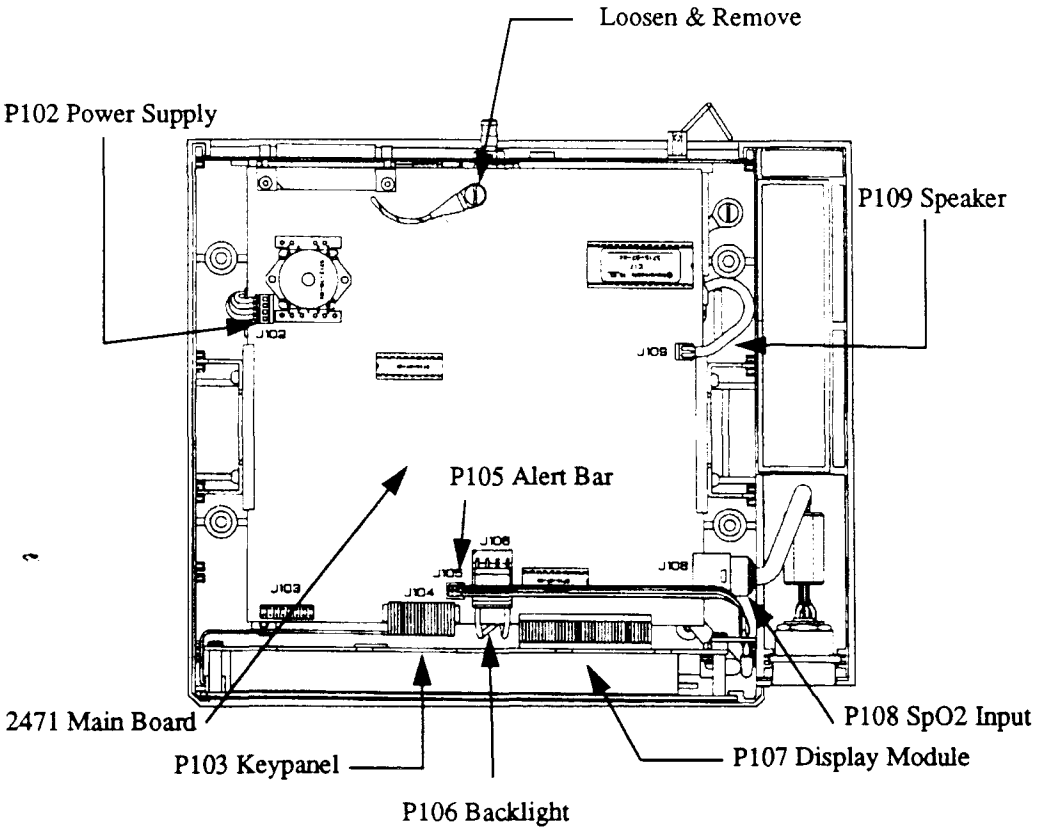

Figure 9. Monitor Assembly

8. Unplug P102 The Power Supply connector from the 2471 Main Board, disconnect P109 (Speaker), P108 (Sensor), P104 (Keypanel), P106 (Backlight), P105 (Alert Bar), and P103 (Display). Unscrew 2471 Main Board from the rear panel. Remove the front Bezel assembly then slide the 2471 Main Board out, the 2472 Power Supply Board and Battery should be exposed.
9. The separate sections of the monitor can now be removed.

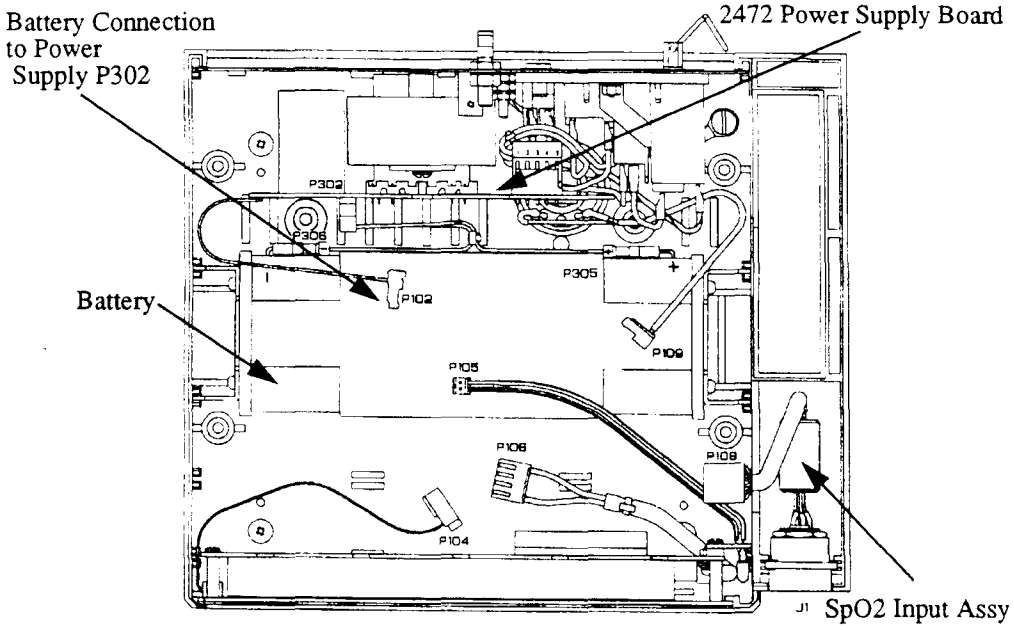

Figure 10. 520A Assembly with 2471 Main Board Removed

10. IMPORTANT. The battery is connected to the Power Supply Board through connector J302. Before attempting to apply power to the monitor ensure all connections are properly made, then connect the AC mains and turn the PEM switch to "I", ensure that the ∿ on the front panel illuminates before powering up.
11. Remove/replace the various assemblies as needed. IMPORTANT: The monitor *will be damaged* if power is applied to it while cables or assemblies are improperly connected.
12. After the monitor is fully assembled perform safety checks. Reconnect the line cord to the AC Mains and to the monitor. Set the AC Mains switch to the "I" (On) position. Verify the ∿ indicator illuminates. Turn the monitor on.
13. Measure the AC leakage current from the monitor's chassis to earth ground with the monitor grounded, ungrounded, and ungrounded reverse polarity. When operating from 100/120 VAC, no leakage current may be greater than 25 µA. If operating at 220/240 VAC, no leakage current may be greater than 50 µA.

14. With the monitor grounded, measure from the AC line to the SaO_2 Input connector pins. When operating from 100/120 VAC, no leakage current may be greater than 25 µA. If operating at 220/240 VAC, no leakage current may be greater than 50 µA.

Changing System Software 10.7

The system software is contained in EPROM IC17 on the 2471 Main Board. New software releases are made available from time-to-time. These new releases may add features or be maintenance upgrades. To install a new EPROM:

1. Follow the steps listed in *Assembly Exchanges* on page 34 to open the monitor. Be sure to disconnect J102 from the 2471 Main Board to ensure that there is no power on the board while changing the system software.
2. Use a small flat-blade screwdriver (or IC extraction tool) to pry the EPROM IC17 from the socket—be careful not to bend the pins.

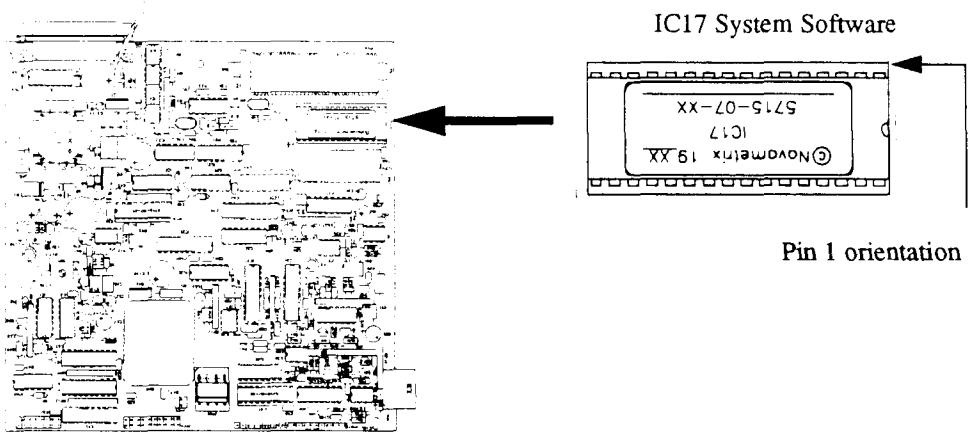

Figure 11. Changing the System Software EPROM

3. Install the new EPROM into the socket. Align the EPROM so that IC17 pin-1 is inserted into pin 1 of the socket.
4. Reverse the above steps to reinstall the assembly into the monitor.

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11 Troubleshooting

Fault, alert and error messages that can appear on the Model 520A Message Center display are described below.

Paragraphs marked with a "☞" are intended for qualified service personnel only.

Message Center Display	Possible Explanation
AUDIO OFF DISABLED	Displayed if user tries to enable Audio Off mode (by pressing and holding the **AUDIO** key) while the "Allow Audio Off" portion of the Options Menu is set to "No".
BAD SIGNAL TIMEOUT	Monitor not receiving valid signals from sensor. May be caused by excessive motion, cardiac arrhythmia or other situations leading to poor signal. Check patient status, reposition sensor.
BATTERY EXHAUSTED CONNECT LINE CORD	Monitor is running on battery power and the battery power has been depleted. Connect line cord to AC Mains power source and set the rear panel switch to "I". ☞ Monitor's rear panel fuse has blown, monitor switched over to battery power and has depleted battery life.
CAN'T I.D. PROBE	Sensor is placed on too thick of a site. Reposition the sensor on a thinner (less opaque) section of tissue. A non-SuperBright™ sensor is connected, use only 87xx series sensors. Sensor is faulty. Remove sensor from use and contact qualified service personnel.
CONNECT SP02 PROBE	Sensor is disconnected from the monitor. Sensor is faulty. Remove sensor from use and contact qualified service personnel. ☞ Both sensor LEDs have failed or the cable connections are open or shorted.
PROBE FAULTY	Sensor faulty. Remove sensor from use and contact qualified service personnel. ☞ This error traps intermittant faults such as Probe Red LED or Infrared LED failures caused by frayed or broken wires in the sensor cable. Whereas PROBE RED or I.R LED FAILED is displayed for as long as the error lasts, Faulty Probe is displayed if those errors cease without the user replacing the faulty sensor.
EVENT MARKED	An event was successfully entered into trend memory.

Message Center Display	Possible Explanation
INCOMPATIBLE PROBE	A non-SuperBright™ sensor is connected, use only 87xx series sensors. Sensor is faulty. Remove sensor from use and contact qualified service personnel.
INSUF. LIGHT **	Insufficient Light, where ** is time in seconds (after 99 seconds display shows "--"). Sensor placed on a site too thick (or opaque) for adequate light transmission. Reposition the sensor. A non-SuperBright™ sensor is connected, use only 87xx series sensors.
LIGHT INTERF.**	Light Interference, where ** is the time in seconds (after 99 seconds display shows "--") ambient light sources (sunlight, warming lights, etc.) are interfering with sensor light sources. Shield the sensor from ambient light sources.
LOW SIGNAL **	Low Signal Strength, where ** is the time in seconds (after 99 seconds display shows "--") that the pulse strength as detected by sensor is too weak for proper monitor operation. Reposition sensor.
MONITOR ERROR	Monitor faulty. Record error message (appearing on bottom line of display) and contact qualified service personnel. ☞ "RAM SELF TEST FAILED" - Ram failed the power up self-test. ☞ "ROM SELF TEST FAILED" - Calculated EPROM checksum not does not equal stored value. Bad EPROM. ☞ "BAD STACK POINTER" - Stack pointer base not at top of stack. ☞ "CORRUPT SYSTEM MMU" - The CPU MMU pointing to an illegal address map. Digital Bd fault. ☞ STACK OVERFLOW" - Stack pointer exceeded allocated stack size. ☞ "DISP BUFFER OVERFLOW" - Display buffer queue exceeded its allocated size. ☞ "HARDWARE ERROR 1" - (1)Main Bd PEEL is defective, (2) Main Bd 20-bit ADCs exceeded acceptable calibration thresholds. ☞ "XXms INT.TIMEOUT" where XX is 10 or 25. The interrupt has interrupted itself. ☞ "ERROR UNDEFINED" - Failed in an unknown state.
MONITOR PERFORMING SELF TEST.	Monitor is performing its power up system diagnostic tests.
Parameters Reset To Factory Default	Displayed when monitor is turned on while pressing the **ALERT RESET** key. Monitor now using factory default settings.

Message Center Display	Possible Explanation
PROBE FAULTY RD	Sensor faulty. Remove sensor from use and contact qualified service personnel. ☞ Sensor Red LED has failed or the cable connections are open or shorted.
PROBE FAULTY IR	Sensor faulty. Remove sensor from use and contact qualified service personnel. ☞ Sensor Red LED has failed or the cable connections are open or shorted.
PROBE OFF PATIENT	Sensor disconnected from patient, improperly applied, or placed on an area too translucent for proper sensor operation. Reposition sensor.
PULSE-HIGH	Selected pulse rate high alert limit has been violated.
PULSE-LOW	Selected pulse rate low alert limit has been violated.
PULSE OUT OF RANGE	Pulse rate is less than 30 bpm or is greater than 250 bpm.
Revision 2.0 APR/28/92	Monitor software revision level. Displayed when monitor is turned on while pressing **AUDIO** key.
SpO2-HIGH	Selected saturation high alert limit has been violated.
SpO2-LOW	Selected saturation low alert limit has been violated.

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12 Functional Test

Introduction 12.1

The Functional Test described below should be performed on each Model 520A Pulse Oximeter monitor and sensor before being placed in the clinical environment. The test verifies overall functional integrity[1] of the monitor and sensors. If the monitor or sensors do not pass these tests, remove from use and contact the Novametrix Service Department for repair/replacement assistance.

Monitor Functional Test 12.2

12.2.1 Equipment Required:
Model 520A to be tested
AC Mains Line Cord (supplied with monitor)
Finger Sensor (Cat. No. 8776) or Y-Sensor™ (Cat. No. 8791)

12.2.2 Visually inspect the monitor and line cord. Verify there is no external damage. Shake the unit to check that there is no loose hardware inside.

12.2.3 Inspect the sensor(s). Verify mechanical integrity.

12.2.4 Check the rear panel power entry module. Verify that it is set to the proper voltage.

12.2.5 Set the AC Mains switch to the "0" (Off) position. Connect the line cord to the monitor and to the AC Mains.

12.2.6 Verify the ∿ (AC Mains) indicator is not illuminated.

12.2.7 Set the AC Mains switch to the "I" (On) position. Verify the ∿ indicator illuminates.

12.2.8 Depress and hold the **ALERT RESET** key. Press the front panel **POWER** key then release both keys. The monitor will;

- Briefly illuminate all displays and indicators[2]
- Produce an audible "beep" indicating the audio is operational
- Briefly display `Parameters Reset To Factory Default`.[3]

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1. See Section 13, *Accuracy Test*, on page 47 for tests that check the accuracy of the monitor.
2. The AC indicator will illuminate only when the monitor is connected to line power and the rear panel Power switch is On (I).
3. This message is only displayed if the ALERT RESET key is depressed at power up.

- Briefly display MONITOR PERFORMING SELF TEST.[4]
- Enter normal operating mode (Run Mode) where;
  - For the first several seconds, the (Two Minute Silence) indicator to the left of the **AUDIO** key will be illuminated, and then turn off.
  - The (bell-shaped Alert) indicator and Red Alert Bar will flash.
  - The message center will display ERASE STORED TRENDS ? for approximately 10 seconds.

12.2.9 Verify the Message Center flashes CONNECT SPO2 PROBE while no sensor is connected to the monitor.

12.2.10 Press the **ALRT** key to display the SET ALERT LIMITS menu.
Press the **SEL** key to select the upper SPO2 limit.
Press the ↓ (down arrow) key several times and verify the Saturation display upper alert limit decreases each time the key is pressed.

12.2.11 Press the **RUN** key. Note the displayed Saturation alert limit settings. Press the **POWER** key twice to turn the monitor off and back on again. After the self-test is complete, verify the monitor "remembered" the alert limit values.

12.2.12 Press the **Menu** key and then the **AUDIO** key.
Press the **ALERT** key to display the SET ALERT VOLUME menu.
Press and hold the ↓ key and verify the volume of the tone decreases as the volume display decreases to 01. Press the ↑ key to return to maximum (07) volume. Press **RUN**.

12.2.13 Press **MENU** then press **LITE**, verify the backlight toggles between dim and bright with each depression.
Press **RUN**.

12.2.14 Press the **Menu** key and then the **AUDIO** key.
Press the **PULSE** key to display the SET AUDIO FEATURES menu.
Press the ↑ key to set the value to 01 then press **RUN**.

12.2.15 Do not apply the sensor to yourself. If using a Y-Sensor, fold the sensor heads so that the windows face (or even touch) each other. Connect the sensor to the monitor. Verify the Message Center flashes PROBE OFF PATIENT and no alarm sounds.

12.2.16 If using a Finger sensor, apply it to your index finger, and if using a Y-Sensor, tape the sensor to your index finger. Verify that after several seconds, reasonable Pulse Rate and Saturation (>95%) values are displayed.

12.2.17 Check that the Message Center displays a Pulse Activity Bar and that a tone sounds with each pulse beat. (Note that the pitch of the tone will vary with the Saturation display value.)

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4. If "Monitor Error" appears, turn the monitor off and back on. If the message reappears, contact qualified service personnel. See Section 11, *Troubleshooting*, on page 39.

12.2.18 Remove the sensor from your finger. Verify the Saturation and Pulse Rate displays blank out, an alarm sounds and PROBE OFF PATIENT is displayed. (If using a Y-Sensor, you may have to fold the heads so that the windows face each other in order to make the alarm and message activate.)

12.2.19 Press and release the **AUDIO** key. The (Two Minute Silence) indicator should illuminate and the alarm should be silenced. After two minutes the indicator turns off and the alarm sounds again (providing the alarm condition still exists).

12.2.20 With the alarm sounding, press and hold the **AUDIO** key until the (Audio Off) indicator illuminates. Verify that the alarm is silenced.

12.2.21 Press and release the **AUDIO** key. Verify the indicator shuts off and the alarm sounds.

12.2.22 With the PROBE OFF PATIENT alarm still sounding, press the **ALERT RESET** key. Verify the message and alert indicators continue to flash but the alarm is silenced.

12.2.23 Set the AC Mains switch to the "0" (Off) position. Verify the unit operates from battery power (provided the battery is substantially charged). Place the AC Mains switch back to the "I" position.

12.2.24 Press the **POWER** key to turn the monitor off and disconnect the sensor.

12.2.25 Depress and hold the **ALERT RESET** key. Press the front panel **POWER** key then release both keys. The monitor will power up with the factory default settings in place. After the self-test is complete, turn the monitor off.

12.2.26 This completes the Model 515A Functional Test. If the monitor and sensor performed as described above, they are functionally operational. If the monitor is to be returned to clinical use, be sure to let the user know that the monitor is now using its default settings—as these may differ from the user's "normal" settings.

Special Power Up Functions 12.3

Each of the Model 515A front panel pushbutton keys is linked to a special "hidden" power up function. To initiate the special function, start with the monitor off and press a front panel key. While still holding that key, press the **POWER** key to turn the monitor on.

AUDIO = Software (EPROM) Revision Level
Turn the monitor on while holding the **AUDIO** key and the monitor's software revision level is displayed in the message center for as long as the **AUDIO** is pressed. Release the key and the monitor continues with its normal power up sequence.

ALERT RESET = Return to factory default settings
Turn the monitor on while holding the **ALERT RESET** key and the monitor resets all its control settings (including alert limits, averaging times, etc.) to the factory default values. A `Parameters Reset To Factory Default` message is briefly displayed and the monitor continues with its normal power up sequence. Note that the system date and time are not affected by this action.

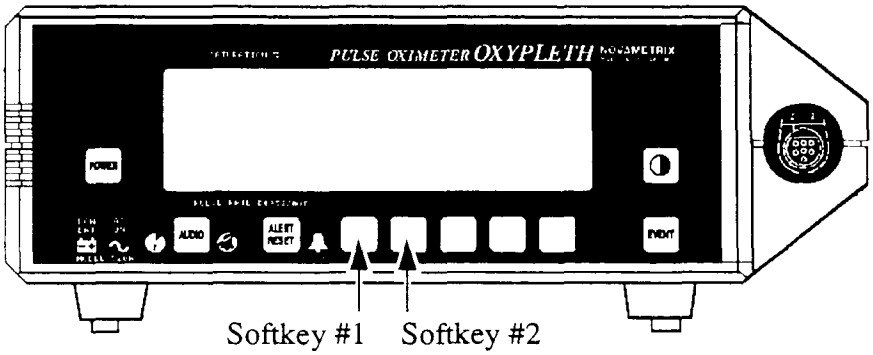

Figure 12. Softkey Identification

Softkey #1 = EPROM Checksum Test, Production Test Mode
Turn the monitor on while holding **Softkey #1** (the leftmost softkey) and the monitor calculates and displays the checksum value of the EPROM containing the system software. See Section 14.4, *EPROM Checksum and Automatic Tests*, on page 49, for a list of proper checksum values. Press and hold **Softkey #3** while the checksum is displayed and the monitor enters Production Test Mode. See Section 14.12, *Production Test Software*, on page 55.

Softkey #2 =Extended Display and Watchdog Test
Turn the monitor on while holding **Softkey #2** (second from left) and all front panel indicators and display segments illuminate for several seconds. The watchdog now resets the monitor which should then execute its normal power up sequence. Note that the ∿ indicator will illuminate only if the monitor is being powered from the AC Mains.

13 Accuracy Test

Introduction 13.1

The Accuracy Test verifies the performance accuracy of the Model 520A Pulse Oximeter monitor. This test is typically performed in conjunction with (after) the tests described in Section 13, *Accuracy Test*, on page 47. If the monitor does not pass the accuracy test, the monitor should be recalibrated. Refer to Section 14, *Calibration Tests*, on page 47 or contact the Novametrix Service Department for repair/replacement assistance.

The test requires the use of the Model TB500B Sensor Simulator.[1] This is the same device used by the factory technicians to calibrate the monitor prior to shipping. The TB500B is an updated version of the TB500A Test Box. Owners of TB500A should contact the Novametrix Service Department for details on upgrading to the TB500B. Note that the TB500A, used in conjunction with the Cat. No. 5453-00 Adapter Cable, may be substituted for the TB500B in most parts of this test.

Monitor Accuracy Test 13.2

13.2.1 Equipment Required:
Model 520A to be tested
AC Mains Line Cord (supplied with monitor)
TB500B Sensor Simulator (Cat. No. 5330-00)
or TB500A Sensor Simulator and Adapter Cable 5453-00.

13.2.2 Press and release the front panel **POWER** key. The monitor will;

- Briefly illuminate all displays and indicators[2]
- Produce an audible "beep" indicating the audio is operational
- Briefly display MONITOR PERFORMING SELF TEST.[3]
- Enter normal operating mode (Run Mode) where;
  - For the first several seconds, the (Two Minute Silence) indicator to the left of the **AUDIO** key will be illuminated, and then turn off.
  - The (bell-shaped Alert) indicator and Red Alert Bar will flash.

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1. Available through the Novametrix Service Department.
2. The AC indicator will illuminate only when the monitor is connected to line power and the rear panel Power switch is On (I).
3. If "Monitor Error" appears, turn the monitor off and back on. If the message reappears, contact qualified service personnel. Refer to Section 11, *Troubleshooting*, on page 39.

13.2.3 Verify the Message Center flashes ERASE STORED TRENDS? for ten seconds then displays CONNECT SPO2 PROBE while no sensor is connected to the monitor.

13.2.4 Press the **Menu** key and then press **AVG** twice.
The SELECT SPO2 AVERAGING menu should be displayed. Press **2s** and then press **RUN** to return to the Main Menu. This sets the SpO_2 averaging to 2-seconds for the quickest response to changing TB500B settings.

13.2.5 Set the TB500B to these settings;
Power - On, Sensor Type[4] - 87xx, Signal Attenuation - 3, Saturation - 92.

13.2.6 Connect the TB500B to the Model 520A SpO_2 Input Connector.
Verify a Pulse Activity Bar appears in the Message Center.
Verify SpO_2 and Pulse Rate values appear after several "pulses".

13.2.7 Set the Signal Attenuation to 1. Verify the Saturation and Pulse Rate displays blank out, an alarm sounds and PROBE OFF PATIENT is displayed. Set the Signal Attenuation to 3 and verify the displays and Pulse Activity Bar return.

13.2.8 Set the Saturation to 0. Verify that after a short delay, LOW SIGNAL appears in the Message Center. Set the Saturation to 100 and verify the displays and Pulse Activity Bar return.

13.2.9 Press and hold the TB500B RED push-button. Verify the monitor alarms and displays PROBE FAULTY RD. Release the button. Check that the alarm continues and PROBE FAULTY is displayed. Disconnect the TB500B from the monitor and then plug it back in. Verify the displays and Pulse Activity Bar return.

13.2.10 Press and hold the TB500B INFRARED push-button. Verify the monitor alarms and displays PROBE FAULTY IR. Release the button. Check that the alarm continues and PROBE FAULTY is displayed. Disconnect the TB500B from the monitor and then plug it back in. Verify the displays and Pulse Activity Bar return.

13.2.11 Press and hold both the TB500B RED and INFRARED push-buttons. Verify the displays blank out and CONNECT SPO2 PROBE is displayed. Release the buttons. Verify the displays and Pulse Activity Bar return.

13.2.12 Disconnect the TB500B from the monitor. Set the Sensor Type switch to 86xx.[5] Reconnect the simulator to the monitor. Verify the message INSUFFIC. LIGHT is replaced in approximately 10 seconds by CAN'T I.D. PROBE, which is itself replaced approximately 20 seconds later by PROBE FAULTY. Return the Sensor Type switch to 87xx. Disconnect the

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4. The 5453-00 Adapter Cable is used instead of the Sensor Type switch for the TB500A.
5. If using a TB500A, disconnect the Adapter Cable and plug the TB500A directly into the Model 520A. The Message Center should display "INCOMPATIBLE PROBE". Install the Adapter Cable between the TB500A and the Model 520A and move on to the next step.

TB500B from the monitor and then plug it back in. Verify the displays and Pulse Activity Bar return.

13.2.13 Press and hold the **AUDIO** key until the (Audio Off) indicator illuminates. This will keep the monitor silent for the remainder of the test.

13.2.14 Verify the displayed SpO_2 value is within the tolerances stated below for each setting of the Signal Attenuation and Saturation switches. Verify a Pulse Rate of 60 bpm ± 1bpm for all switch settings. (Note that alert messages will be generated and displayed as the saturation value violates the alert limit settings.)

TB500B		520A	520A SpO_2
SAT	ATTEN	SpO_2	(w/ TB500A)
100	3	99 ± 1	99 ± 1
92	3	92 ± 2	92 ± 2
82	3	82 ± 2	84 ± 2
72	3	72 ± 2	77 ± 2
62	3	62 ± 2	69 ± 2
100	7	99 ± 1	99 ± 1
92	7	92 ± 4	92 ± 4
82	7	82 ± 4	84 ± 4
72	7	72 ± 4	77 ± 4
62	7	N/A	N/A

Table 3. SpO2 Display tolerances for TB500B settings

13.2.15 Press the **Menu** key and then press **AVG**. Press the appropriate key to return the averaging to its pretest value.
Press **RUN** to return to the Main Menu.

13.2.16 This completes the Monitor Accuracy Test. If the monitor does not meet the above listed specifications, refer to Section 14, *Calibration Tests*, on page 47, or contact the Novametrix Service Department for recalibration, repair, or replacement information.

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14 Calibration Tests

Introduction 14.1

The Calibration Tests verify the calibration and operation of the electronic circuits within the Model 520A Pulse Oximeter. These tests do NOT need to be performed on a regular (preventative maintenance) basis. Perform these tests only if the monitor fails to operate as expected and/or fails the *Functional Test* on page 40 and/or the *Accuracy Test* on page 47. Calibration Tests should be performed only by qualified service personnel. The Model 520A contains static sensitive devices. Follow proper grounding procedures when handling the internal components to avoid damage from static discharge.

The test requires the use of the Model TB500B[1] Sensor Simulator Test Box. This is the same device used by the factory technicians to calibrate the monitor prior to shipping. The TB500B is an updated version of the TB500A[2] Test Box.

If the monitor does not pass the Calibration Tests, remove it from use and contact the Novametrix Service Department for repair/replacement assistance.

This procedure assumes the technician performs each step as indicated—leaving the monitor in a known state prior to performing the next step. If steps are omitted or performed out of order, be sure that the monitor is set to the correct state before continuing.

Equipment Required and Test Setup 14.2

14.2.1 Model 520A to be tested
AC Mains Line Cord (supplied with monitor)
TB500B Sensor Simulator (Cat. No. 5330-00)
or TB500A Sensor Simulator and Adapter Cable 5453-00.
Digital Voltmeter
Small Flat-blade screwdriver
Saturation Test Jack[3] (See *Test Fixtures* on page 59.)
RS232 Test Fixture (Cat. No. 5479-01. See *Test Fixtures* on page 59.)

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1. Available through the Novametrix Service Department.
2. The TB500A, used in conjunction with the Cat. No. 5453-00 Adapter Cable, may be substituted for the TB500B in most parts of this test.
3. This Test Jack differs from the type used on earlier models, see Test Fixtures section for schematic.

14.2.2 Turn the Model 520A Off. Disconnect the line cord and sensor from the monitor.

14.2.3 Flip the monitor over to expose the bottom cover and remove the four cover screws. Holding both the top and bottom halves together, flip the monitor over again and set it on its bottom cover.

14.2.4 Lift the top cover from the monitor and set it aside. Set the Red Alert Bar lens aside with the cover for safe keeping.

Power Supplies 14.3

14.3.1 With the line cord disconnected from the monitor and the power switch set to "0" remove P102 from J102 on the 2471 Main Board.

14.3.2 Remove the 2471 Main Board, See *Assembly Exchanges* on page 34.

14.3.3 NOTE: The Power Supply/Rear Panel Assembly can be lifted from the chassis for easy access.
Unplug P302 from J302 on the Power Supply/Rear Panel Assembly, this disconnects the battery. Measure the voltage across the battery leads verify at least 11.5 volts DC.

14.3.4 Connect the line cord to the Power Entry Module (PEM), be careful line voltage is now present on the Power Supply/Rear Panel Assembly. Set the power switch to "I", measure the voltage at J302, verify 13.2 VDC.

14.3.5 Measure the voltage at E302 pins 1 and 4 (use pin 4 as ground reference), verify approximately 23 VDC. Measure the voltage between pins 3 and 4, verify 5 volts DC.

14.3.6 Set the power switch Off "0", remove the line cord from the PEM. Reassemble the Power Supply/Rear Panel Assembly, connect the battery P302 to J302 on the Power Supply Board, reassemble the 2471 Main Board and display/Keypanel Assembly.
NOTE: Be sure all connections are oriented properly to avoid damage to the unit.

14.3.7 Reconnect the line cord and place the power switch On "I" position. Verify the ∿ indicator on the front panel illuminates.

14.3.8 Press the front panel **POWER** key to turn the monitor on.

14.3.9 All measurements are with respect to analog ground, use the back side of R4, R5 or R6 located to the right of T1. Monitor ferrite bead FB1(near IC16) with a DVM and adjustVR1 for 5.00 Vdc.

14.3.10 Verify the following voltages are within specification;

IC40-4 .....-11.50Vdc to -12.50Vdc (-V12)
IC40-8 .....+11.50Vdc to +12.50Vdc (+V12)
IC20-28 .....+4.50Vdc to 4.80Vdc (Vback)

14.3.11 Using E1 as ground reference (green wire at rear of 2471 Main Board) measure the voltage at IC1 pin 16, verify 4.75-5.25 Vdc.

14.3.12 Press the front panel **POWER** key to turn the monitor off.

EPROM Checksum and Automatic Tests 14.4

14.4.1 Short out capacitor C90 by installing a jumper wire from R59 to R56 as shown.

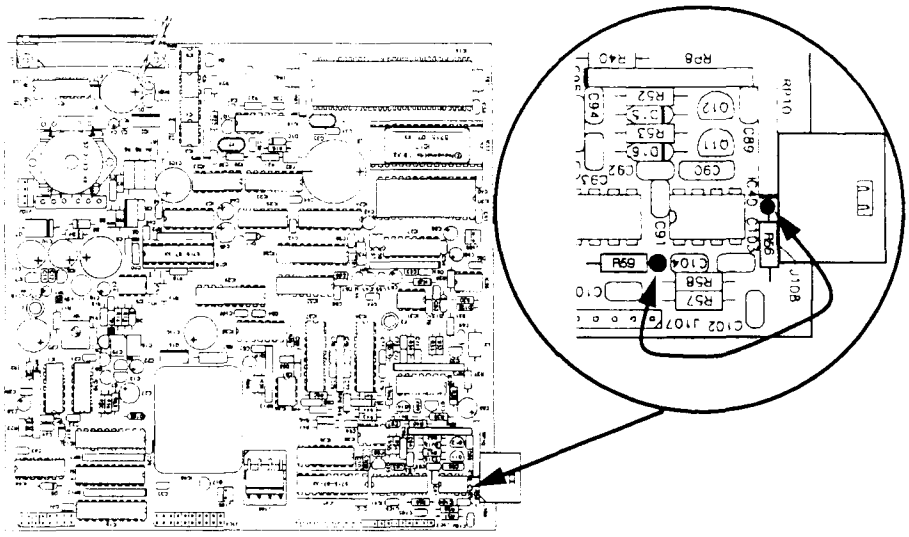

Figure 13. Installation of Jumper Wire on 2471 Main Board

14.4.2 Press and hold the **AUDIO** key. While still holding in the **AUDIO** key, press the **POWER** key to turn the monitor on. The monitor will display the EPROM revision level and date. Note these and then turn the monitor off.

14.4.3 Press and hold the leftmost softkey. While still holding in the leftmost softkey, press the **POWER** key to turn the monitor on. The monitor displays `Calculating Checksum` followed by `Checksum = xxxx Hex`, where xxxx is determined by the EPROM revision level. Verify the correct checksum from the table below.

Language	Rev 2.0
English	3B16
German	68B0
Portuguese	661E
Spanish	31BF

Table 4. System EPROM Checksums

Note: The software calibration tests described in this section are based on Revision 2.0 software. Other software revisions may perform differently.

14.4.4 Turn the monitor off. Once again, turn on the monitor while holding in the leftmost softkey—but this time when `Checksum = xxxx Hex` is

displayed, release the leftmost key and press and hold the third softkey from the left until Novametrix Inc. Production Test appears.

14.4.5 After a few seconds the display will change to MONITOR TEST - 1.

14.4.6 Press **Test**. The display changes to Automatic Test. Press **Test**.

- The monitor begins a series of tests. If any test fails, the monitor beeps and displays which test failed; it then displays MONITOR TEST - 2.
- The RAM, ROM and RTC (real time clock) tests run unattended.
- The volume ramping test produces tones of decreasing volume. The tones repeat until the technician presses **PASS** (or **FAIL**).
- The frequency ramping test produces tones of differing frequencies (pitch). The tones repeat until the technician presses **PASS** (or **FAIL**).
- The RS232 test will display Insert test plug which requires the RS232 Test Fixture. When installed the technician is required to press **Cont.** then follow the display prompts to complete the tests.
- The 8 bit and 20 bit ADC tests will run next and Install SAT tst jack will be displayed. When installed the technician is required to press **Cont.**
- If the tests pass, TEST No 1 - PASSED is briefly displayed. The monitor then displays MONITOR TEST - 2.

Keyboard Test 14.5

14.5.1 At the MONITOR TEST - 8 display, press **Test** and Key board Test is displayed. Press **Test**. Follow the display prompts and press the appropriate keys. On completion, a test pass or fail message is briefly displayed. The monitor then displays MONITOR TEST - 9.

Mains Detect Test 14.6

14.6.1 At the MONITOR TEST - 9 display, press **Test** and Mains detect test is displayed. Press the **Test** softkey, if the mains is on then MAINS ON will be displayed, if the mains is turned off then MAINS OFF will be displayed. Press **quit** to continue.

Low Battery Check 14.7

14.7.1 Set the AC Mains switch to the "0" (Off) position. Verify the unit continues to operate, uninterrupted, from battery power (provided the battery is substantially charged).

14.7.2 Operate the monitor from battery power. Verify that the 🔋 (low battery) indicator illuminates as the voltage across the battery terminals drops to between +11.8 and +11.7 volts. Note that battery life is two hours, so this

step may take quite a while to verify. (The 🔋 will remain illuminated until the battery voltage is raised above +11.9 volts.)

14.7.3 Disconnect the DVM, place the AC Mains switch back to the "|" position and turn the monitor off.

Functionality and Accuracy 14.8

14.8.1 With the monitor initially off. Depress and hold the **ALERT RESET** key. Press the front panel **POWER** key then release both keys. The monitor will;

- Briefly illuminate all displays and indicators[4]
- Produce an audible "beep" indicating the audio is operational
- Briefly display Parameters Reset To Factory Default.[5]
- Briefly display MONITOR PERFORMING SELF TEST.
- Enter normal operating mode (Run Mode) where;
  - For the first several seconds, the (Two Minute Silence) indicator to the left of the **AUDIO** key will be illuminated, and then turn off.
  - The (bell-shaped Alert) indicator and Red Alert Bar will flash.

14.8.2 Verify the Message Center flashes SAVE STORED TRANDS ? for approximately 10 seconds then displays CONNECT SPO2 PROBE while no sensor is connected to the monitor.

14.8.3 Press the **ALRT** key to display the SET ALERT LIMITS menu.
The ◀ should be pointing at the SPO2 upper limit.
Press the ↓ (down arrow) key several times and verify the Saturation display upper alert limit decreases each time the key is pressed.

14.8.4 Press the **RUN** key. Note the displayed Saturation alert limit settings. Press the **POWER** key twice to turn the monitor off and back on again. After the self-test is complete, verify the monitor "remembered" the alert limit values.

14.8.5 Press the **MENU** key and then the **AUDIO** key.
Press the **ALERT** key to display the SET ALERT VOLUME menu.
Press and hold the ↓ key and verify the volume of the tone decreases as the volume display decreases to 01. Press the ↑ key to return to maximum (07) volume. Press **RUN**.

14.8.6 Press **MENU** then press **LITE**, verify the backlite toggles between dim and bright with each depression.

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4. The AC indicator will illuminate only when the monitor is connected to line power and the rear panel Power switch is On (I).
5. This message is only displayed if the ALERT RESET key is depressed at power up.

14.8.7 Press the AUDIO key and then the PULSE key to display the SET PULSE VOLUME menu.
Press the ↑ key to set the value to 01 then press **RUN**.

14.8.8 Press the **MENU** key and then press **AVG**.
The SELECT SPO2 AVERAGING menu should be displayed. Press **2s** and then press **RUN** to return to the Main Menu.

14.8.9 Set the TB500B to these settings;
Power - On, Sensor Type[6] - 87xx, Signal Attenuation - 3, Saturation - 92.

14.8.10 Connect the TB500B to the Model 520A SpO_2 Input Connector.
Verify a Pulse Activity Bar appears in the Message Center.
Verify SpO_2 and Pulse Rate values appear after several "pulses".
Verify a tone sounds with each pulse beat. (Note that the pitch of the tone will vary with the Saturation display value.)

14.8.11 Set the Signal Attenuation to 1. Verify the Saturation and Pulse Rate displays blank out, an alarm sounds and PROBE OFF PATIENT is displayed.

14.8.12 Press and release the **AUDIO** key. The (Two Minute Silence) indicator should illuminate and the alarm should be silenced. After two minutes the indicator turns off and the alarm sounds again (providing the alarm condition still exists).

14.8.13 With the alarm sounding, press and hold the **AUDIO** key until the (Audio Off) indicator illuminates. Verify that the alarm is silenced.

14.8.14 Press and release the **AUDIO** key. Verify the indicator shuts off and the alarm sounds.

14.8.15 With the PROBE OFF PATIENT alarm still sounding, press the **ALERT RESET** key. Verify the message and alert indicators continue to flash but the alarm is silenced.

14.8.16 Set the Signal Attenuation to 3 and verify the displays and Pulse Activity Bar return.

14.8.17 Set the Saturation to 0. Verify that after a short delay, LOW SIGNAL appears in the Message Center. Set the Saturation to 100 and verify the displays and Pulse Activity Bar return.

14.8.18 Press and hold the TB500B RED pushbutton. Verify the monitor alarms and displays PROBE FAULTY RD. Release the button. Check that the alarm continues and PROBE FAULTY is displayed. Disconnect the TB500B from the monitor and then plug it back in. Verify the displays and Pulse Activity Bar return.

14.8.19 Press and hold the TB500B INFRARED pushbutton. Verify the monitor alarms and displays PROBE FAULTY IR. Release the button. Check that

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6. The 5453-00 Adapter Cable is used instead of the Sensor Type switch for the TB500A.

the alarm continues and PROBE FAULTY is displayed. Disconnect the TB500B from the monitor and then plug it back in. Verify the displays and Pulse Activity Bar return.

14.8.20 Press and hold both the TB500B RED and INFRARED pushbuttons. Verify the displays blank out and CONNECT SPO2 PROBE is displayed. Release the buttons. Verify the displays and Pulse Activity Bar return.

14.8.21 Disconnect the TB500B from the monitor. Set the Sensor Type switch to 86xx.[7] Reconnect the simulator to the monitor. Verify the message INSUFFIC. LIGHT is replaced in approximately 10 seconds by CAN'T I.D. PROBE, which is itself replaced approximately 20 seconds later by PROBE FAULTY. Disconnect the TB500B from the monitor. Return the Sensor Type switch to 87xx and then plug it back in. Verify the displays and Pulse Activity Bar return.

14.8.22 Press and hold the **AUDIO** key until the (Audio Off) indicator illuminates. This will keep the monitor silent for the remainder of the test.

14.8.23 Verify the displayed SpO_2 value is within the tolerances stated below for each setting of the Signal Attenuation and Saturation switches. Verify a Pulse Rate of 60 bpm ± 1bpm for all switch settings. (Note that alert messages will be generated and displayed as the saturation value violates the alert limit settings.)

TB500B		520A	520A SpO_2
SAT	ATTEN	SpO_2	(w/ TB500A)
100	3	99 ± 1	99 ± 1
92	3	92 ± 2	92 ± 2
82	3	82 ± 2	84 ± 2
72	3	72 ± 2	77 ± 2
62	3	62 ± 2	69 ± 2
100	7	99 ± 1	99 ± 1
92	7	92 ± 4	92 ± 4
82	7	82 ± 4	84 ± 4
72	7	72 ± 4	77 ± 4
62	7	N/A	N/A

Table 5. SpO_2 Display tolerances for TB500B settings

14.8.24 Turn the monitor off. Disconnect line cord and TB500B from the monitor.

7. If using a TB500A, disconnect the Adapter Cable and plug the TB500A directly into the Model 520A. The Message Center should display "INCOMPATIBLE PROBE". Install the Adapter Cable between the TB500A and the Model 520A and move on to the next step.

14.8.25 Replace the Red Alert Bar lens cap. Verify the circuit boards and front and rear panels are properly positioned in the bottom cover, then slide the top cover back into place—be careful no to pinch the input connector wires.

14.8.26 Hold the two halves together and flip the monitor over to expose the bottom cover. Install the four cover screws.

Safety Checks 14.9

14.9.1 Reconnect the line cord to the AC Mains and to the monitor. Set the AC Mains switch to the "I" (On) position. Verify the ~ indicator illuminates. Turn the monitor on.

14.9.2 Measure the AC leakage current from the monitor's chassis to earth ground with the monitor grounded, ungrounded, and ungrounded reverse polarity. When operating from 100/120 VAC, no leakage current may be greater than 25 µA. If operating at 220/240 VAC, no leakage current may be greater than 50 µA.

14.9.3 With the monitor grounded, measure from the AC line to the SaO_2 Input connector pins. When operating from 100/120 VAC, no leakage current may be greater than 25 µA. If operating at 220/240 VAC, no leakage current may be greater than 50 µA.

Completion Of Tests 14.10

14.10.1 Press the **POWER** key to turn the monitor off.

14.10.2 Depress and hold the **ALERT RESET** key. Press the front panel **POWER** key then release both keys. The monitor will power up with the factory default settings in place. After the self-test is complete, turn the monitor off.

14.10.3 This completes the Model 520A Calibration Tests. If the monitor performed as described above, is correctly calibrated and functionally operational. If the monitor is to be returned to clinical use, be sure to let the user know that the monitor is now using its default settings—as these may differ from the user's "normal" settings.

Test Fixtures 14.11

Tests fixtures references in the Calibration Tests are diagramed below.

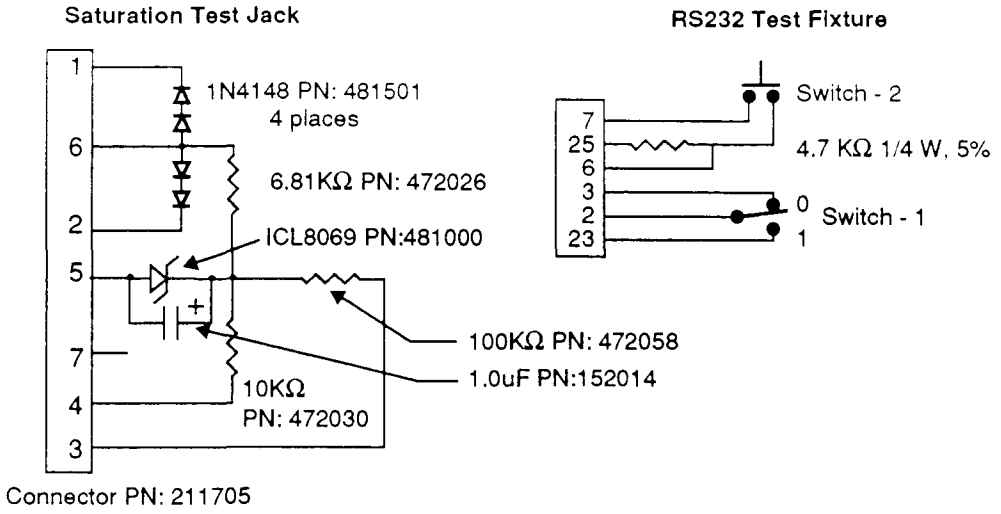


Figure 14. Test Fixture Schematics

Production Test Software 14.12

Several "Monitor Tests" have been included in the Model 520A software (EPROM). These tests are used to calibrate and check the operation of portions of the monitor's circuitry.

The calibration tests outlined earlier in this section of the manual provide full instructions on using Monitor Tests as part of the calibration procedure. The explanations that follow are meant to help a qualified technician verify and/or troubleshoot the internal electronics of the monitor.

Note: The Monitor Tests described here are based on Revision 2.0 software. Other software revisions may contain different Monitor Tests.

To enter Production Test mode:

14.12.1 Turn the monitor off. Press and hold the leftmost softkey. While still holding in the leftmost softkey, press the **POWER** key to turn the monitor on. When the monitor displays `Calculating Checksum` release the leftmost softkey and quickly press and hold the third softkey from the left. The display changes to `Checksum = xxxx Hex` (xxxx varies based on the software and revision level) and then changes again to `Novametrix Inc. Production Test` and then `MONITOR TEST 1`.

The thirteen (13) Monitor Tests in Revision 2.0 software use a similar format:

- Use the **Next** or **Prev** keys to advance or backup through the tests as needed.
- Press the **Test** key to display the test name and press **Test** again to begin the test.

- The **Quit** key causes the Quit Prod'n Test ? message to be displayed. Press **No** to return to the Production Tests or press **Yes** to restart the monitor (the monitor performs a self test and then enters its normal operational menu).

Monitor Test 1 - Automatic Test 14.12.1

This test automatically sequences through monitor tests 2, 3, 4, 5, 6, 7, 10 and 11. If any failures are encountered the monitor will default to MONITOR TEST 2.

Monitor Test 2 - RAM Test 14.12.2

The monitor writes to each RAM location then reads back what it had written to verify that all bits are good.

Monitor Test 3 - ROM Checksum test 14.12.3

The checksum of the program IC is calculated and checked against the checksum value stored in the EPROM, this is to verify correct software is installed.

Monitor Test 4 - Real Time Clock test 14.12.4

The RTC is checked against certain limits to verify that it is operating correctly. Running this test will reset the date and time to factory defaults.

Monitor Test 5 - Audio Volume Test 14.12.5

The monitor varies the volume level of an audible tone. The test can be run from within the Automatic Test or independently through Monitor Test 5.

If MONITOR TEST 5 is selected and run an audible tone sounds. Use the **Dec** and **Inc** keys to vary the volume level of the tone. Press **Next** to exit the test.

As part of the Automatic Test (MONITOR TEST 1), the monitor sounds a tone and continuously varies the volume. **PASS** and **FAIL** keys are displayed. Select **PASS** if the volume decreases in steps and then repeats the sequence. Press **FAIL** if the volume does not vary. A pass advances to the next test, while fail drops out of the test to MONITOR TEST 2.

Monitor Test 6 - Audio Frequency Test 14.12.6

The monitor varies the frequency (pitch) of an audible tone. The test can be run from within the Automatic Test or independently through Monitor Test 6.

If MONITOR TEST 6 is selected and run an audible tone sounds. Use the **Dec** and **Inc** keys to vary the frequency (pitch) of the tone. Press **Next** to exit the test.

As part of the Automatic Test (MONITOR TEST 1), the monitor sounds a tone and continuously varies its frequency. **PASS** and **FAIL** keys are displayed. Select **PASS** if the frequency changes. Press **FAIL** if the frequency does not vary. A pass advances to the next test, while fail drops out of the test to MONITOR TEST 2.

Monitor Test 7 - Rs232 loopback Test 14.12.7

The RS232 lines are checked by connecting the receive and transmit lines and verifying the signal loop is complete. A test fixture is required to perform the test. (See *Test Fixtures* on page 59.)

Monitor Test 8 - Key board Test 14.12.8

The monitor checks for a response from each of the front panel keys.

Monitor Test 9 - Mains detect test 14.12.9

This test checks that the monitor can successfully distinguish whether it is operating from its internal battery or from the AC Mains. The test can be run from within the Automatic Test or independently through Monitor Test 9.

If MONITOR TEST 9 is selected and run, the message MAINS ON (AC operation) or MAINS OFF (battery operation) is displayed. With the line cord connected, change the position of the rear panel switch to change the messages—there may be a several second delay before the message changes. Press **quit** to exit the test.

As part of the Automatic Test (MONITOR TEST 1), the monitor displays messages to turn the AC Mains on and off. Follow the message prompts.

Monitor Test 10 - 20 bit ADCs Test 14.12.10

This test requires shorting out C90 on the 2471 Main Board (refer to Section 14.4, *EPROM Checksum and Automatic Tests*, on page 53) and the use of the Saturation Test Jack. (See *Test Fixtures* on page 59.) The monitor will calibrate the two 20 bit ADCs to analog ground then check each channel (Red and Infrared) for the expected voltage generated by the test jack. There will be a install SAT tst jack prompt when this test is selected, ensure the proper test jack[8] is installed then press **cont**. If the test passes, 20 BIT ADC TEST PASSED will be displayed.

Monitor Test 11 - 8 bit adc test 14.12.11

This test requires the use of the Saturation Test Jack. (See *Test Fixtures* on page 59.) After the test jack is connected and the **cont** key is pressed, the monitor checks each

8. Test Jacks used on earlier models will not work, be sure that the Test Jack being used matches that shown in the Test Fixtures section of this manual.

of the eight ADC channels. The message `testing 8 bit adc -X` is displayed where X the channel being tested. If all tests pass the monitor exits the test, otherwise a message identifies which test failed. Note that unless the monitor is being operated from the AC Mains, the channel 6 test may fail. Refer also to Monitor Test 12.

Monitor Test 12 - Display ADC channels 14.12.12

Test 12 displays the hexadecimal values of the 8-bit ADC channels and the values of the two 20-bit ADCs. Use the **inc** and **dec** keys to select the various channels. Press **exit** return to the monitor test menu. The table below shows the acceptable limits and test conditions for the various channels.

Channel	Min	Max	Test Condition
1	00	FF	All conditions (spare chan)
2	13	1B	Saturation Test Jack installed
3	D8	FF	Saturation Test Jack installed
4	61	780	Saturation Test Jack installed
5	B6	E4	Saturation Test Jack installed
6	00	FF	AC Mains Power
7	B6	E4	Saturation Test Jack installed
0	00	FF	All conditions
RED	532C0	5BED0	Saturation Test Jack installed
IR	532C0	5BED0	Saturation Test Jack installed

Table 6. Monitor Test 12, ADC Limits

The last item "Led pwr = 20" controlls the VLED voltage level that can be measured at IC30 pin 8. It therefore is not a measurement but a control, the voltage level can be increased or decreased by the softkeys (**inc** or **dec**). The value on the display can be varied from 20-FE Hex and corresponds to 0.5 - 4.0 volts dc at IC30 pin 8. The RED and IR values above will be affected if this is adjusted, however if Monitor Test 10 is run it will be reset to 20.

Monitor Test 13 - 520A -> PC Interface 14.12.13

This test is not used. It was designed as a software development/debugging tool and serves no purpose for units in the field.

15 Connecting to other Equipment

The Model 520A Pulse Oximeter communicates with external equipment via its rear panel (25 pin D style female) connector. The monitor can be connected to RS232 compatible (digital) equipment. If the optional Analog Output Module is connected, the monitor can output to analog devices such as strip chart recorders. Refer to the Model 520A Pulse Oximeter User's Manual (Catalog No. 5693-23) for further information on the RS232 and analog outputs listed below.

Connecting the ThinkJet Printer 15.1

To connect the Hewlett-Packard ThinkJet Printer to the Model 520A:

1. The Hewlett-Packard ThinkJet must be a Model 2225D (RS-232C interface).
2. Set the dip switches on the rear panel of the ThinkJet.
   Mode switches = 1, 2, 5, 6 up (on) and 3, 4, 7, 8 down (off).
   RS-232C switches = 1 up (on) and 2, 3, 4, 5 down (off).

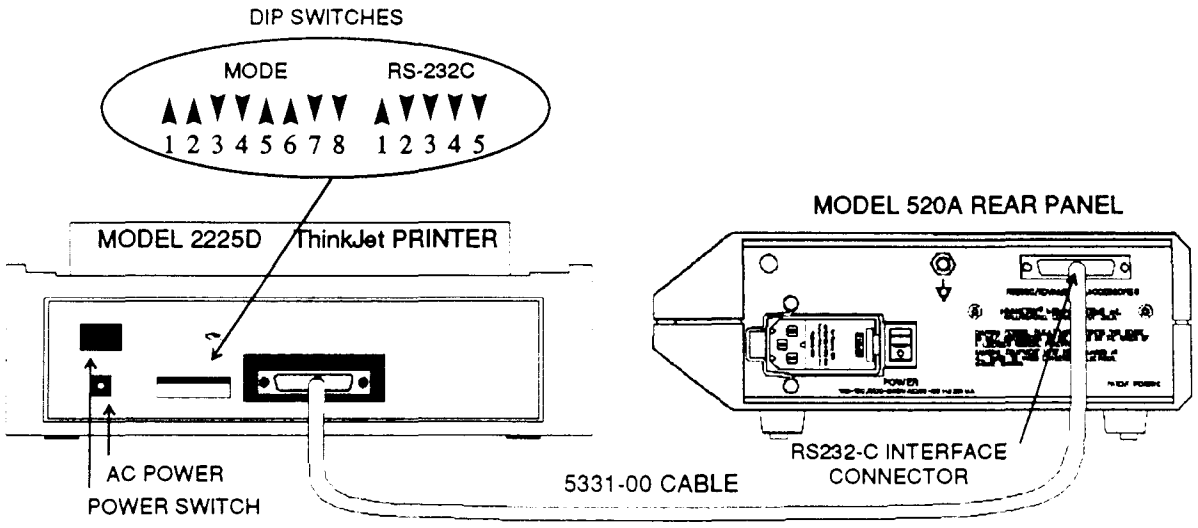


Figure 15. Connecting the ThinkJet Printer

3. Connect the interface cable, PN:5331-00, to the Model 520A RS232C connector and to the ThinkJet. (If Model 520A has an Analog Module attached, connect to the module's RS232C connector.)

4. Connect the printer's AC input and turn the printer on.
5. Select **T-Jet** (ThinkJet) from the **Ser.** (Serial) portion of the Model 520A Options Menu.
6. Refer to the ThinkJet Owner's Manual for further printer details.

Connecting the Model 315 Printer 15.2

To connect the Model 315 Printer to the Model 520A:

1. Set the dip switches on the Model 315 rear panel.
   The settings are; 1-5 up (off), 6-7 down (on), and 8 up (off).
2. Connect the printer interface cable, PN:4913-00, to the RS232C connector[1] on the Model 520A. Connect the other end of the cable to the Model 315.

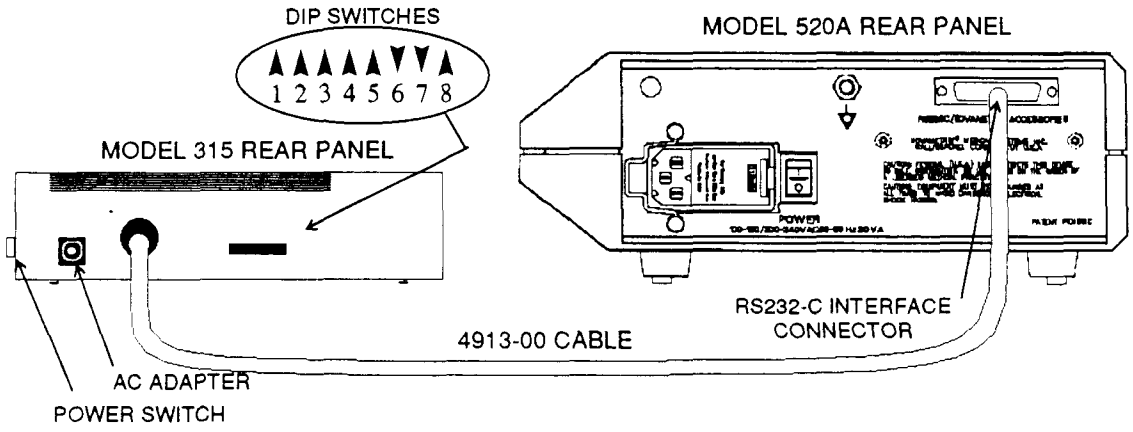


Figure 16. Connecting the Model 315 Printer

3. Connect the printer's AC adapter (if desired).
4. *Turn the printer on first*, then turn the Model 520A on.
5. Select **315** from the **Ser.** (Serial) portion of the Model 520A Options Menu.
6. Refer to the Model 315 documentation for further printer details.

Connecting Seiko DPU-411 Thermal Printer 15.3

To connect the SIEKO Model DPU-411 Thermal Printer to the Model 520A:

1. Set the DIP switches located on the bottom of the DPU-411.
   First bank of eight switches; 1,2 down (off), 3,4 up (on), 5,6 down (off), 7,8

up (on).
Second bank of six switches; 1-3 up (on), 4-6 down (off).

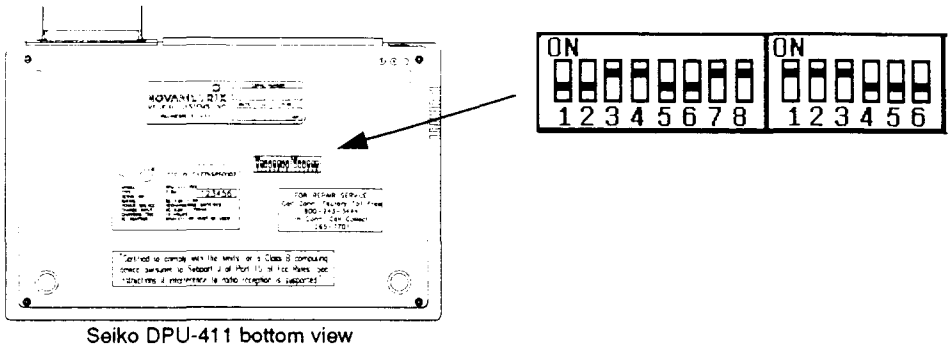


Figure 17. Configuration of Seiko Thermal Printer.

2. Connect the printer interface cable, PN:5861-00, to the RS232C connector on the Model 520A. Connect the 25 pin connector at the other end to the 25 pin D connector on the rear panel of the DPU-411 (upper connector).
   Plug the cable DC power plug into the rear jack of the Model DPU-411.

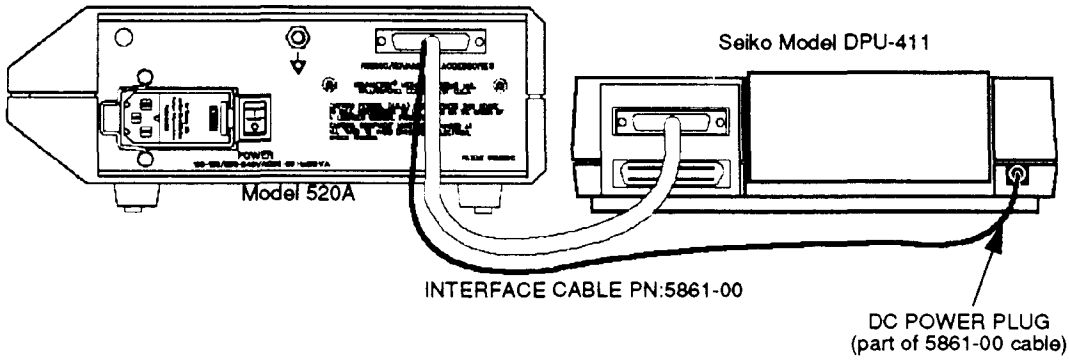


Figure 18. Connecting the Seiko Model DPU-411 Printer.

3. *Turn the printer on first*, then turn the Model 520A on.
4. Select **Seiko** from the **Ser.** (Serial) portion of the Model 520A Monitor Options 2 Menu.
5. Refer to the Seiko Model DPU-411 documentation for further printer details.

Analog Output Module 15.4

The *optional* Analog Output Module (Catalog Number 9622-01), provides the necessary analog output voltages for use with analog instruments such as strip chart recorders. (The Model 520A does not directly support analog devices.)

The Analog Output Module attaches to the connector on the rear panel of the Model 520A and provides analog output voltages, via a 9-pin connector, and RS232C pass through, via a 25-pin connector, so that both analog and serial devices can be used simultaneously.

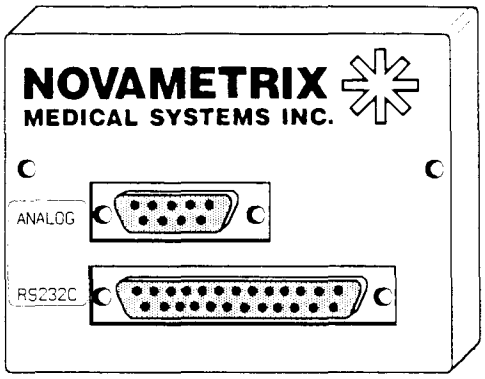
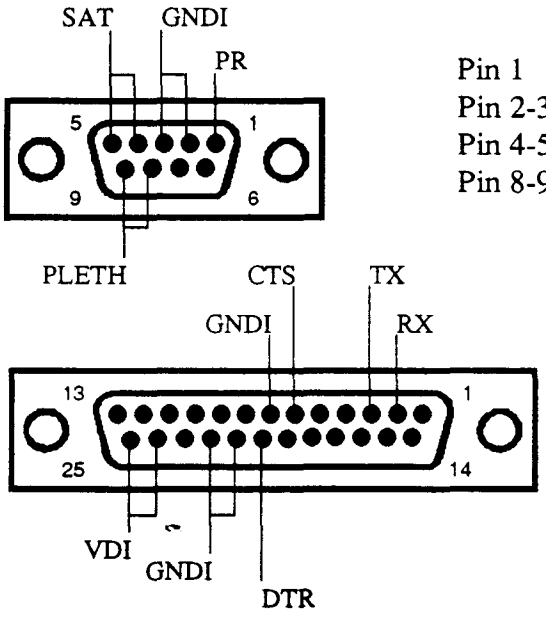


Figure 19. Analog Output Module

Two screws, supplied with the module, are passed through the module and screw into the pre-tapped holes in the rear panel of the Model 520A to secure the Analog Output Module in place. The pinouts of the 9-pin analog and 25-pin RS232C connector are shown below.



Pin 1	Pulse Rate, 4mV/bpm, 0-1V
Pin 2-3	GNDI (Interface ground)
Pin 4-5	Saturation, 10mV/%, 0-1V
Pin 8-9	Plethysmogram, 0-1V (Auto Gain Control)

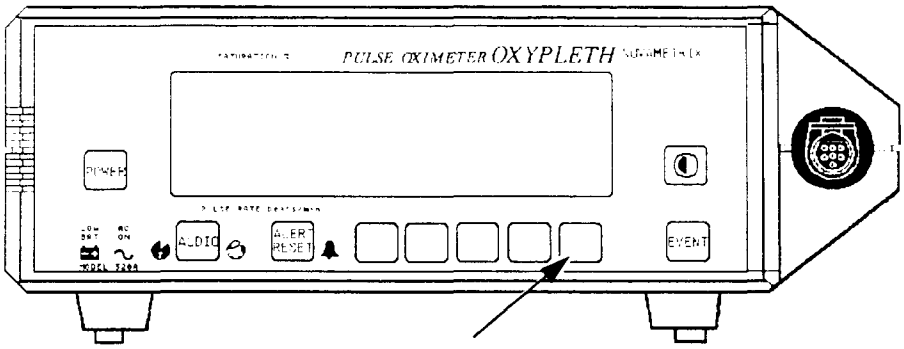
Pin 2	RX (Receive In)
Pin 3	TX (Transmit Out)
Pin 6	CTS (Clear To Send (input))
Pin 7	GNDI (Interface ground)
Pin 20	DTR (Data Transmit Ready (output))
Pin 21-22	GNDI (Interface ground)
Pin 24-25	VDI (Interface +5 volts)

Figure 20. Analog Output Module Pinouts

Analog Output Setup 15.5

A CALIBRATE RECORDER menu within the Model 520A software allows the user to easily calibrate analog recorders to the voltage levels produced by the Analog Output Module. To access this feature:

1. With the monitor in normal running mode press and hold the **MENU** key until SPO2 SETUP OPTIONS appears on the display. Press the **NEXT** key until MONITOR OPTIONS 2 appears on the display. Select **REC** for CALIBRATE RECORDER menu.



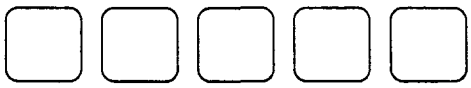
Press and hold for 5 seconds while in normal running mode

Figure 21. Analog Output Setup

2. The Recorder Outputs menu will be displayed.

CALIBRATE RECORDER

RUN ZERO HALF FULL PREV



- **RUN** - return to Monitoring Mode
- **ZERO** - set analog outputs to 0 volts
  (0% = 0 volts, 0 bpm = 0 volts, pleth = 0 volts)
- **HALF** - set analog output voltages to half scale
  (50% = 0.50 volts, 125 bpm = 0.50 volts, pleth = 0.50 volts)
- **FULL** - set analog output voltages to full scale
  (100% = 1.00 volt, 250 bpm =1.00 volts, pleth =1.00 volts)
- **PREV** - returns to MONITOR OPTIONS 2 menu.

3. Press the **ZERO** key and adjust the analog baselines on the recorder. Press the **FULL** key and adjust the recorder full scale deflection. Press the **HALF** key and

check that the recorder registers at half scale.

Signal	Analog Connector Pin #	Min-Max Voltages (Referenced to Pins 2 + 3)		
		ZERO	HALF	FULL
Pulse Rate	1	0.000-0.012	0.477-0.520	0.955-1.030
Saturation	4 + 5	0.000-0.012	0.477-0.520	0.955-1.030
Plethysmogram	8 + 9	0.000-0.012	0.477-0.520	0.955-1.030

Table 7. Analog Output Module Voltage Tolerances

Note: Earlier versions of the Analog Output Module have a 2.5 volt maximum scale for the Plethysmogram and Pulse Rate (1.25 volt half scale).

4. When the recorder is properly adjusted, press the **RUN** key. The monitor will return to Monitoring Mode and automatically begin outputting analog data to the Analog Output Module.

   Note: This setup procedure does not have to be performed each time the monitor is turned on—the monitor will always automatically output analog information via the Analog Output Module, this procedure simply helps to calibrate the recorder to the Model 520A signals.

16 Specifications

General 16.1

Below are specifications for the Novametrix Model 520A Pulse Oximeter. These specifications are listed for informational purposes only, and are subject to change without notice.

Oxygen Saturation (SpO_2) Section 16.2

- Range, 0-100%
- Accuracy (1 standard deviation), 80-100% ± 2%, 0-79% unspecified
- Display Resolution, 1%
- Averaging Time, Menu selectable times of 2 or 8 seconds
- Audible SpO2 Trend Feature
  Pitch of (user selectable) Pulse Rate "beep" tracks the SpO2 value (i.e., decreasing SpO2 values are signalled by lower pitched "beeps") Sixteen (16) different pitches are linked to the upper SpO2 alarm limit setting.
- Settling Time
  Display settles to within 1% of the final reading less than 15 seconds after the sensor is properly applied.
- Alerts
  Continuously displayed. Menu selectable high and low limits. Visible alarm is immediate. Audible alarm occurs after 10 seconds of continuous violation of the set limit. Limit values are retained in memory when monitor is turned off, or the monitor can be set to use its default settings each time it is turned on.

Pulse Rate (PR) Section 16.3

- Range, 30-250 beats per minute (bpm)
- Accuracy (1 standard deviation), ± 1% of full scale
- Display Resolution, 1 bpm
- Averaging Time, Menu selectable times of 2 or 8 seconds
- Settling Time
  Display settles to within 1% of the final reading less than 15 seconds after the sensor is properly applied.
- Alerts
  Continuously displayed. Menu selectable high and low limits. Visible alarm is

immediate. Audible alarm occurs after 10 seconds of continuous violation of the set limit. Limit values are retained in memory when monitor is turned off, or the monitor can be set to use its default settings each time it is turned on.

General Specifications 16.4

- Operating Environment
  10-40 °C (50-104° F)
  0-90% relative humidity (non-condensing)
- Weight, approximately 7 lbs. (3.18 kg)
- Dimensions
  Height, 3.3 inches (8.38 cm)
  Width, 9 inches (22.86 cm)
  Depth, 8 inches (20.32 cm)
- Power, 100/120/220/240 VAC ± 10%, 50/60 Hz
- Fuse Rating
  U.S. specification: 0.5 A, 250 V, Slo-Blo
  European specification: T 250 mA/250 V (x2)
- Battery
  Type, lead-acid gel-cell
  Battery Life,4 hours
  (Note: Excessive alerting reduces battery life.) When 15 minutes of battery life remain, the "low battery" indicator illuminates. When the battery becomes exhausted, the monitor shuts off. Connect to AC power to recharge battery.
  Recharge Time, battery fully recharged in 12-15 hours max.

Additional Features 16.5

- 2 Minute Silence
  When **AUDIO** key is pressed, deactivates audible alerts for two minutes.
  Indicated by illuminated 2 MIN LED.
- Audio Off
  Feature user selectable. If enabled, press and hold **AUDIO** key for 3 seconds, and audible alarms will not activate.
  Indicated by flashing OFF LED.
- Trend Memory
  Trend memory print of 3 hours, 6 hours, 12 hours or 24 hours when used with Model 315 Printer, Seiko DPU-411 Thermal Printer or the Hewlett-Packard ThinkJet Printer.
- Analog (Recorder) Output Module—Optional
  Provides analog output for strip chart applications at the following levels;
  Oxygen Saturation value, 100% = 1 V.
  Pulse Rate value, 250 bpm = 1V.
  Plethysmograph pulse waveform, 0-1V max (AGC)

- Serial (RS232) Data Output
  Provides RS232 data interface compatible with;
  Novametrix Model 315 Printer
  Hewlett-Packard ThinkJet Printer
  Seiko DPU-411 Thermal Printer
  Novametrix Model 1260 Capnograph
  Novametrix Model 1010 Telemetry Central Station
  SARACAP® monitor
  RS232 computer interface
- Internal Real Time Clock
- Alert Bar

17 Accessories

Model 520A

Catalog No.	Description
5693-00	***OXYPLETH* Pulse Oximeter, Model 520A,** with choice of sensor

OxySnap℠ SpO_2 SENSORS

8793	OxySnap**Y-Sensor** (use with OxySnapExtention Cable)
8744	OxySnap**Finger Sensor** (use with OxySnapExtention Cable)
8853	OxySnap**Extension Cable**, 8 ft. (use with OxySnapsensors)
8898	OxySnap**Long Extension Cable**, 12 ft. (use with OxySnapsensors)

OxySnapSENSOR ACQUISITION PLANS

Select an OxySnap**Finger Sensor or Y-Sensor Plan** for each SuperBright™ Pulse Oximeter. The plan you select determines the warranty period—12, 24 or 36 months.
How the Plans Work: Included in each Plan are TWO sensors—one for immediate use, the other one for back-up. If a sensor becomes inoperative, place the back-up sensor into use and return the inoperative sensor in the convenient pre-paid mailer. A replacement sensor will be shipped within two business days of receipt of the inoperative sensor. This simple return/replacement method will be used for the entire warranty period, thereby, guaranteeing your costs and virtually eliminating sensor tracking hassles.
Warranty: The Plan warranty (not individual sensors) is 12, 24 or 36 months. Replacement sensors provided under terms of the Plan shall carry the remaining Plan warranty—replacements do not extend the warranty.

8793-12	**Y-12 Plan** The Plan warranty is 12 months. Includes 3 boxes (your choice) of any Y-Strip Taping Systems
8793-24	**Y-24 Plan** The Plan warranty is 24 months. Includes 6 boxes (your choice) of any Y-Strip Taping Systems
8793-36	**Y-36 Plan** The Plan warranty is 36 months. Includes 9 boxes (your choice) of any Y-Strip Taping Systems
8744-12	**Finger-12 Plan** The Plan warranty is 12 months.
8744-24	**Finger-24 Plan** The Plan warranty is 24 months.
8744-36	**Finger-36 Plan** The Plan warranty is 36 months.

Y-STRIP™ TAPING SYSTEMS

8828	**20mm Wrap Style Y-Strip Taping System** (100 per box) Use on neonatal foot and hand, or on pediatric toe or finger 20mm tapes use Blue color coded liners
8829	**25mm Wrap Style Y-Strip Taping System** (100 per box) Use on neonatal foot and hand 25mm tapes use Green color coded liners

Catalog No.	Description
8831	**20mm Finger Style Y-Strip Taping System** (100 per box) Use on pediatric finger or on small adult finger 20mm tapes use Blue color coded liners
8832	**25mm Finger Style Y-Strip Taping System** (100 per box) Use on adult finger 25mm tapes use Green color coded liners
8836	**Non-Adhesive Foam Wraps** (25 per box)

OTHER SpO_2 SENSORS

8776	**SuperBright™ Finger Sensor** (10 ft sensor cable)
8791	**SuperBright™ Y-Sensor** (10 ft sensor cable)
8789	**Special Use SuperBright™ Finger Sensor** (8 inch sensor cable)
5238	**Special Use SuperBright™ Finger Sensor** & 25 ft. shielded cable

PRINTERS

5702-00	**Seiko DPU-411 Thermal Printer**, 120 vac (interface cable included)
5703-00	**Seiko DPU-411 Thermal Printer**, 220 vac (interface cable included)
300017	**Seiko DPU-411 Thermal Printer Paper** (5 rolls per box)
5140-00	**Hewlett-Packard ThinkJet Printer** (interface cable included)
300013	**Hewlett-Packard ThinkJet Printer Ink Cartridge**
300014	**Hewlett-Packard ThinkJet Printer Paper** (2500 sheets Z-fold)
4912-00	**Model 315 Printer** (interface cable included)
4917	**Thermal printer paper for Model 315 Printer** (8 rolls per box)

ACCESSORIES

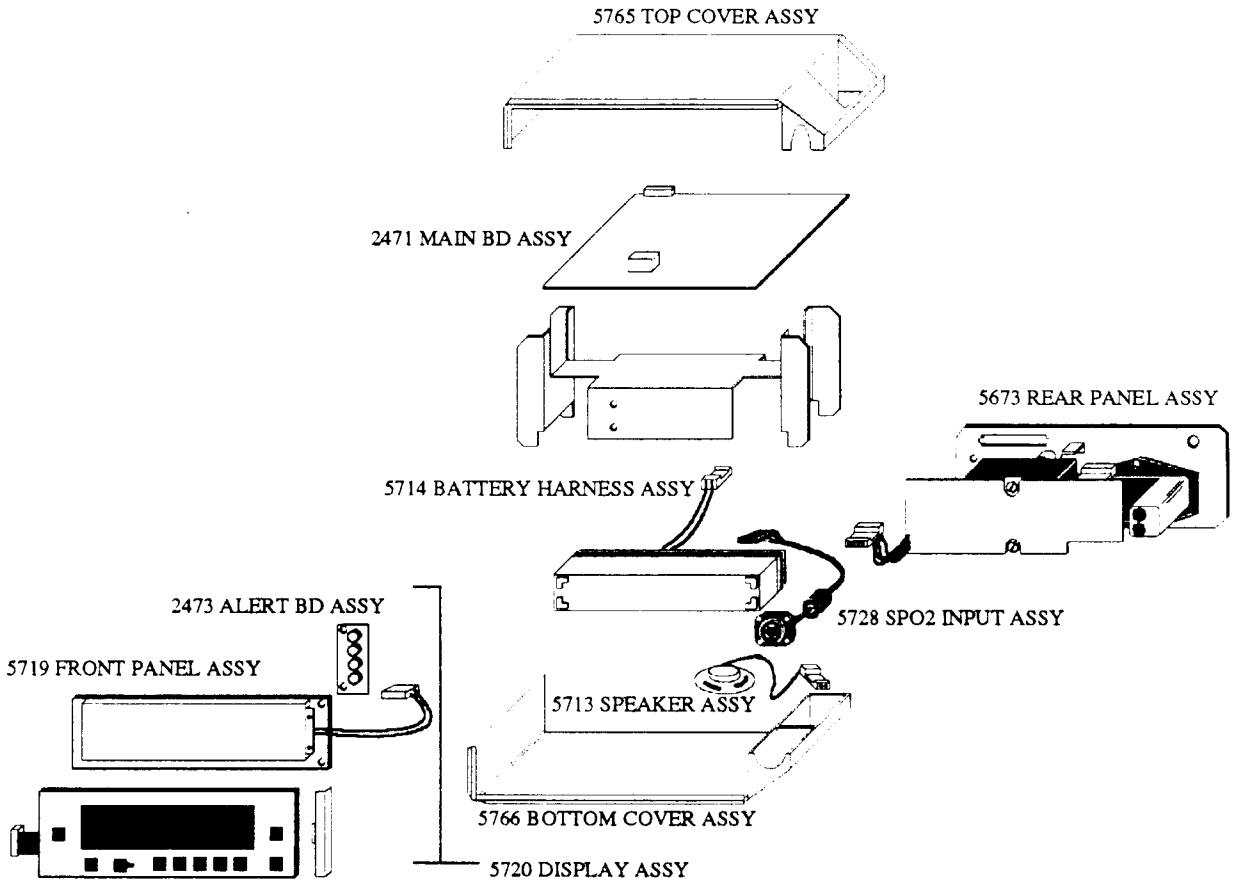
9622	**Analog Module** (includes RS232 pass-thru)
7106-10	**Transport Pouch** (for *OXYPLETH*)
7104-10	**Side Pouch** for accessories (included with monitor)
600026	**Power Cord** (included with monitor)
4941	**Saturation Sensor Extension Cable**— 4 feet
4942	**Saturation Sensor Extension Cable**— 6 feet
4943	**Saturation Sensor Extension Cable**—10 feet
5266	**Saturation Sensor Extension Cable**—25 feet
5333	**Cable** for (Optional) Analog Output Module (open ended)
5334	**Cable** Serial Output to Personal Computer (with 25-pin connector)
5335	**Cable** Serial Output to Personal Computer (with 9-pin connector)
5134	**Cable** to Model 1260 Capnograph
5331	**Cable** to Hewlett-Packard ThinkJet Printer
4913	**Cable** to Model 315 Printer
5694	**Cable** to Seiko DPU-411 Printer
5861	**Cable** Seiko DPU-411 Printer (powers printer from *OXYPLETH*)
4729	**Cable** (Optional) Analog Output Module to Models 302/312 Recorder
4832	**Cable** RS232/SARA/SARAcap Interface
5726	**Cable** Analog Output Module to Aequitron 9500 Series Monitor

Catalog No.	Description
	Custom Cables—Consult factory for specifications and pricing
	MOUNTING SYSTEMS
140030	**Wall Mount**
140031	**Wall Mount** (less Wall Channel)
140032	**Pivot Block Mount**
140033	**Transport Mount** (without swivel head)
140034	**Transport Mount** (with swivel head)
140035	**Countertop Mount** 11 inch Base
140036	**Countertop Mount** 5 inch Base
140037	**Portable Instrument Housing**
140038	**Rollstand**
	EXTENDED WARRANTY
	Normal warranty: Monitor—1 year, Finger Sensor—6 months
5693-81	***OXYPLETH* Model 520A Pulse Oximeter** (Total Warranty: Monitor—2 years)
5693-85	***OXYPLETH* Model 520A with Finger Sensor** (Cat No. 8744) (Total Warranty: Monitor—2 years, Finger Sensor—2 years)
5693-86	***OXYPLETH* Model 520A with Finger Sensor** (Cat No. 8744) (Total Warranty: Monitor—3 years, Finger Sensor—3 years)
8744-83	**Additional 8744 when monitor is covered** (Total Warranty: Finger Sensor—2 years)
	BIOMEDICAL ENGINEERING SERVICE TEST KIT
	Service Test Kits include items and materials qualified service personnel may require to determine the functional integrity and/or accuracy of the system.
5777-00	**Service Test Kit, *OXYPLETH* Model 520A Pulse Oximeter**
9999-96	**"focus" Technical Training Seminar** (1 day course) (For class schedules call: 1-800-243-3444 Ext. 2567)

18 Parts Lists

Family Tree 18.0.1

The Model 520A diagram below shows the individual assemblies of the finished product— the 5693-00 Final Assembly.



5693-01 02 MAIN ASSY, MODEL 520A 18.0.2

LINE	PART NO	REV	QPA	DESCRIPTION
0001	2471-01	01	1	MAIN BOARD ASSY, OXYPLETH - 520A
0002	5664-10	04	1	CHASSIS, MODEL 520A
0003	5673-01	00	1	REAR PANEL ASSY, OXYPLETH - 520A
0004	5693-04	00	0	TEST PROCEDURE, MODEL 520A

LINE	PART NO	REV	QPA	DESCRIPTION
0005	5713-01	00	1	SPEAKER ASSY, OXYPLETH - MODEL 520A
0006	5714-01	00	1	BATTERY HARNESS ASSY, MODEL 520A
0007	5719-01	00	1	FRONT PANEL ASSY, OXYPLETH - 520A
0008	5728-01	02	1	CABLE ASSY, SAO2 INPUT, OXYPLETH - 520A
0009	5765-01	00	1	TOP COVER ASSY, MODEL 520A
0010	5766-01	01	1	BOTTOM COVER ASSEMBLY, MODEL 520A
0011	5855-10	00	1	FOAM LINER, 1/2 X 1/2 X 1/8 THK
0012	9621-16	02	1	LENS, ALERT, MODEL 515
0013	140002		2	CARD GUIDE, 2.5" L, SNAP-IN, NYLON, WHITE
0014	161067		0	TAPE, CL CELL, POLYCHLOROPRENE, .47(12)W
0015	284200		0	#4-40 X 1/4 SLOTTED BINDING HEAD STEEL CAD
0016	286205		0	6-32 X 3/4 S.B.H. CAD PLATED
0017	286220		0	SCREW, 6-32 X 3/16, SLTD BINDING HD, STEEL,
0018	400024		1	BATTERY, 12V, 1.9 AMP HOUR, LEAD ACID
0019	515023		2	1/2A 250V SLO-BLO (IEC127-111 5X20)

2471-01 01 MAIN BOARD ASSY, OXYPLETH - 520A 18.0.3

LINE	PART NO	REV	QPA	DESCRIPTION
0001	2471-02	01	1	FAB, MAIN BOARD, MODEL 520A
0002	2471-03	00	0	SCHEMATIC, MAIN BOARD, OXYPLETH, MODEL 520A
0003	5711-10	01	0	TRANSFORMER, MAIN BD, MODEL 520A
0003	5712-10	00	1	TRANSFORMER, MAIN BD, MODEL 520A
0004	5715-07	20	1	PROGRAM, EPROM ASSY, SP02, MODEL 520A
0005	9715-07	10	1	PROGRAM, PEEL ASSY, CSI0 CONTROLLER
0006	9716-07	10	1	PROGRAM, PEEL ASSY, TIMING SEQUENCER
0007	2471-04	00	0	TEST PROCEDURE, MAIN BOARD, MODEL 520A
0011	152040		3	CAPACITOR, 2.2UF, 35V, TANTALUM
0012	152045		6	CAPACITOR, 10UF 16V 0.2" PITCH
0013	152066		1	CAPACITOR, 220UF, 63V, RADIAL, ELECTROLYTIC
0014	152072		1	CAPACITOR, 10UF, 50V, 20%, AL, ELCTLT, .1 SPA
0015	152073		4	CAPACITOR, 100UF, 16V, 20%, ALUM, ELCTLT, .10
0016	152075		2	CAPACITOR, 47UF, 25V, 20%, AL, ELCTLT, RADIAL
0017	152084		2	CAPACITOR, 470UF, 25V, 20%, AL, ELCTLYTC, .2
0018	152085		2	CAP, 1200UF, 16V, 20%, AL, ELECTROLYTIC, .3 S
0019	152086		2	CAPACITOR, 1000UF, 16V, 20%, AL, ELCTLYTC, .2
0020	153003		1	CAPACITOR, .01UF,50V, O.1 PITCH, X7R
0021	153006		4	CAPACITOR, 47PF, 63V, +80% TO -20%, .100 SPAC
0022	153012		4	CAPACITOR, 22PF, 100V, 2%, .1 SP, METAL CERAMIC
0023	153013		3	CAPACITOR, 33PF, 100V, 2%, .1 SP, METALL CERAMIC
0024	153021		1	CAPACITOR, .47UF,MULTILAYER CERAMIC
0025	153038		1	CAPACITOR, .001UF, 50V, 5%, .1 PITCH, SHORT L
0026	153046		1	CAPACITOR, 4700PF, 100V, 10%, CERAMIC PLATE,
0027	153051		1	CAPACITOR, .22UF, 50V, 20%, .1(2.54)SP, MLTLY
0028	154016		59	CAPACITOR, .1UF, 50V, .100 SPACING, DIPPED RAD
0029	154057		1	CAPACITOR, 470PF, 100V, 10%, .2(5) SP, POLYCARB
0030	154058		1	CAPACITOR, .022UF, 100V, 10%, .2 SP, MET POLY

LINE	PART NO	REV	QPA	DESCRIPTION
0031	154060		1	CAPACITOR, .22UF, 63V, 10%, .2(5) SP, MET POLY
0032	154065		5	CAP, .1UF, 63V, .2 (5MM) SP, POLYESTER FILM
0034	154076		2	CAPACITOR, .01UF, 63V, 1%, POLYPROPYLENE, RAD
0035	180004		1	CHOKE, 100UH, 10%, SHIELDED
0036	180010		1	INDUCTOR, 18UH, 10%, PC MOUNT, .2 (5) SPACING
0037	180011		1	FERRITE BEAD, 22 AWG TCW WIRE THRU CORE
0038	180012		1	FERRITE BEAD, .138(3.5)OD, .031(.8)ID
0039	210051		1	CONNECTOR, 25 PIN, RECEPTACLE, R ANGLE, PC MNT
0039	211213		2	CONNECTOR, 2 PIN, POST HEADER
0041	211414		1	CONNECTOR, 4 PIN, PLUG, FRICTION LOCK, PC MNT
0042	211412		1	CONNECTOR, 4 PIN, HEADER, R ANGLE, PC MNT
0044	211629		1	CONNECTOR, 6 PIN, PLUG, SIL, R ANGLE, PC MNT
0045	212501		1	20 PIN CONNECTOR I/O HEADER
0046	212529		1	CONNECTOR, 20 PIN, HEADER, STRAIGHT, .025 SQ
0047	215031		2	IC SOCKET, 20 PIN
0048	215060		1	SOCKET, IC, 32 PIN, DIP, .6 SPACING
0049	230006		1	CRYSTAL,3.2768MHZ
0050	230016		1	CRYSTAL, 32.768K HZ
0051	230018		1	CRYSTAL, 12.288MHZ, HC49U CASE, .192 SPACING
0052	400035		1	INVERTER, DC TO AC, 5VDC INPUT, PC MOUNT
0053	470111		3	RESISTOR, .33 OHM, 1/2W, 10%, METAL FILM
0054	471400		1	RESISTOR, 100M OHM, 1W, 5%, .9 PITCH
0055	472003		4	RESISTOR, 100 OHM, 1/4W, 1%, CARBON
0056	472007		5	RESISTOR, 475 OHM, 1/4W, 1%, CARBON
0057	472011		5	RESISTOR, 1K OHM, 1/4W, 1%, CARBON
0058	472021		1	RESISTOR, 4.75K OHM, 1/4W, 1%, CARBON
0059	472030		6	RESISTOR, 10K OHM, 1/4W, 1%, CARBON
0060	472034		1	RESISTOR, 12.1K OHM, 1/4W, 1%, CARBON
0061	472037		2	RESISTOR, 13.7K OHM, 1/4W, 1%, CARBON
0062	472041		2	RESISTOR, 20K OHM, 1/4W, 1%, CARBON
0063	472058		6	RESISTOR, 100K OHM, 1/4W, 1%, CARBON
0064	472063		1	RESISTOR, 162K OHM, 1/4W, 1%, CARBON
0065	472067		1	RESISTOR, 221K OHM, 1/4W, 1%, CARBON
0066	472105		2	RESISTOR, 3.92K OHM, 1/4W, 1%, CARBON
0067	472121		1	RESISTOR, 3.74K OHM, 1/4W, 1%, CARBON
0068	472146		1	RESISTOR, 47.5K OHM, 1/4W, 1%
0069	472170		1	RESISTOR, 22.1K OHM, 1/4W, 1%
0070	472193		1	RESISTOR, 23.7K OHM, 1/4W, 1%
0071	472195		4	RESISTOR, 41.2K OHM, 1/4W, 1%, CARBON
0072	472198		1	RESISTOR, 3.3 OHM, 1/4W, 1%, CARBON
0073	472200		1	RESISTOR, 5.6 OHM, 1/4W, 1%
0074	472204		1	RESISTOR, 1 OHM, 1/4W, 1%
0075	472227		2	RESISTOR, 47 OHM, 1/4W, 1%, METAL FILM
0076	472246		2	RESISTOR, 66.5K OHM, 1/4W, 1%, METAL FILM
0077	472267		1	RESISTOR, 22 OHM, 1/4W, 1%, METAL FILM
0078	472268		1	RESISTOR, 8.66K OHM, 1/4W, 1%, METAL FILM
0079	472272		1	RESISTOR, 59K OHM, 1/4W, 1%
0080	472274		1	RESISTOR, 26.7 OHM, 1/4W, 1%

LINE	PART NO	REV	QPA	DESCRIPTION
0081	472276		2	RESISTOR, 6.49K OHM, 1/4W, 1%
0082	474032		1	RESISTOR, 10 OHM, 1/2W, 5%, CARBON
0083	474089		2	RESISTOR PACK, 100K OHM, 2%, 8 RES, 9 PIN, SIP
0084	474098		4	RESISTOR PACK, 100K, 2%, 5 RESISTORS, 10 PIN,
0085	474131		1	RESISTOR PACK, 10K OHM, 2%, 5 BUS RES, 6 PIN,
0086	474132		2	RESISTOR PACK, 41K OHM, 2%, 4 ISOL RES, 8 PIN
0087	474133		1	RESISTOR PACK, 10 OHM, 2%, 4 ISOL RES, 8 PIN,
0088	474134		1	RESISTOR PACK, 41K OHM, 2%, 8 BS RES, 9 PIN,
0089	474135		1	RES PACK, 100 OHM, 2%, 5 ISOL RES, 10 PIN, SIP
0090	475034		1	POTENTIOMETER, 2K OHM, 10%, 1 TURN, TOP ADJ,
0091	481031		1	DIODE, ZENER, BZX79-C7V5, 7.5V, 500MW, DO-35
0092	481501		10	DIODE, 1N4148, SILICON, GENERAL PURPOSE SIGNAL
0093	481534		2	DIODE, BAT82, SCHOTTKY, MINIATURE, DO-34 PACK
0094	481541		4	DIODE, UF4002, 100V, 1A, FAST RECOVERY
0095	481542		1	DIODE, UF5400, 50V, 3A, FAST RECOVERY
0096	483002		1	2N3906PNP SILICON SWITCHING & AMPLIFIER TRANS
0097	483017		4	TRANSISTOR, BC214C, PNP, SILICON
0098	484014		1	NPN TRANSISTOR ZTX109C
0099	484515		1	LM317LZ
0100	484523		1	VOLTAGE REGULATOR, LM79L05ACZ, NEGATIVE, 100M
0101	484529		1	VOLTAGE REGULATOR, LM78L05ACZ, 5V, 100MA
0102	484531		1	VOLTAGE REGULATOR, 78M05CKC, +5V, 500MA
0103	484533		1	VOLTAGE REGULATOR, LP2950ACZ-5.0, ADJ
0104	484534		1	VOLTAGE REGULATOR, LM79L12ACZ, -12VDC, TO-92
0105	484535		1	VOLTAGE REGULATOR, LM78L12ACZ, +12VDC, TO-92
0106	485520		2	TRANSISTOR, BS250, P-CHANNEL MOSFET
0107	485527		1	MOSFET, IRF9523, .8 OHMS, 60V, P-CHANNEL
0108	485529		7	TRANSISTOR, VN0610L, N-CHANNEL, ENHANCEMENT
0109	485531		1	TRANSISTOR, SMP30N10, N-CHAN ENHANCEMENT MODE
0110	486256		1	IC, HM62256LP-12, 32K STATIC RAM
0111	486268		1	IC, DG444DJ, SPST CMOS ANALOG SWITCH, 4 CHANNEL
0113	486276		1	IC, DS232CPE, DUAL RS-232-C RECEIVER/TRANSMIT
0114	486285		1	IC, HD64180R1P6, HIGH INTEGRATION CMOS 8-BIT
0115	486295		1	IC, MM74HC4051N, 8-CHANNEL ANALOG MULTIPLEXER
0116	486298		1	IC, MM74HC4020N, 14-STAGE BINARY CNTR, H SP,
0117	486299		2	IC, CS5503JP, 20-BIT A TO D CONVERTER
0118	486300		1	IC, TLC549IP, 8-BIT CONV, SER CONTROLLED, 4MH
0119	486305		1	IC, MSM6242BRS, CMOS REAL TIME CLOCK/CALENDAR
0120	486600		1	IC, CD4013B, DUAL D-TYPE FLIP FLOP
0121	486606		1	CD4093BE QUAD 2 INPUT NAND GATE
0122	486625		3	MC74HC32N I.C. QUAD 2 INPUT OR GATE
0123	486651		1	MM74HC138 I.C. 3 TO 8 LINE DECODER
0124	486675		2	MM74HC14N, IC,CMOS
0125	486680		5	MM74HC573N, IC, CMOS
0126	486685		1	AD7528JN, IC, CMOS INTERFACE
0127	486712		2	TLO74CN QUAD F FET LOW OFF SET OP AMP
0128	487053		1	IC, AD712JN, DUAL BIFET OPERATIONAL AMPLIFIER
0129	487061		1	IC, TBA820M, MONOLITHIC INTEGRATED AUDIO AMP,

LINE	PART NO	REV	QPA	DESCRIPTION
0130	487064		4	IC, CNY17-III, PHOTON COUPLED ISOLATOR
0131	487065		1	IC, UC3843N, CURRENT MODE PWM CONTROLLER
0132	487069		1	IC, LT1019CN8-2.5, VOLTAGE REFERENCE, 16V
0133	486255		1	IC, SN76496AN, PROGRAMMABLE TONE GENERATOR
0134	515071		1	FUSE, 1/10A, 125V, VERY FAST-ACTING, PLUG-IN
0135	515072		1	FUSE, 1A, 125V, VERY FAST-ACTING, PLUG-IN
0136	515511		2	FUSEHOLDER, VERT, 5A, 125V, PC MOUNT, SILVER
0137	470025		1	RESISTOR, 120 OHM, 1/4W, 10%, CARBON
0138	5833-01	00	1	GROUND WIRE ASSY, MAIN BOARD, OXYPLETH - 520A
0141	486791		1	IC, TLE2022CP, DUAL HIGH SPEED LO PWR OP AMPL
0142	216029		0	TEST TERMINAL
0143	210097		1	CONNECTOR, 16 PIN, HEADER, DIL, .1(2.5)SP, ST
0144	153052		1	CAPACITOR, .022UF, 50V, X7R, .100 SPACING
0145	474086		1	RESISTOR PACK, 10K OHM, 2%, 8 RES, 9 PIN, SIL

2472-01-00 POWER SUPPLY BOARD ASSY, MODEL 520A 18.0.4

ITEM	PART NO.	REV.	QPA	DESCRIPTION
0001	2472-02	02	1	FAB, POWER SUPPLY BOARD, MODEL 520A
0002	2472-03	00	0	SCHEMATIC, POWER SUPPLY BOARD, MODEL 520A
0003	2472-04	01		TEST PROCEDURE, POWER SUPPLY BOARD
0003	5710-10	00	1	TRANSFORMER, MAINS, MODEL 520A
0011	152029		1	CAPACITOR, 220UF 20%, 35V, ALUM, ELECTROLYTIC
0012	152081		1	CAPACITOR, 6800UF, 35V, 20%, AL, ELECTROLYTIC
0013	154016		5	CAPACITOR, .1UF, 50V, .100 SPACING
0014	180014		1	INDUCTOR, 25UH, .25 SPACING, PC MOUNT
0015	211213		1	CONNECTOR, 2 PIN, POST HEADER
0016	211505		1	CONNECTOR, 5 PIN, HEADER, .156 SP, FRICTION
0017	470026		1	RESISTOR, 150 OHM, 1/4W, 10%, CARBON
0018	472005		1	RESISTOR, 249 OHM, 1/4W, 1%, CARBON
0019	472016		1	RESISTOR, 2.21K OHM, 1/4W, 1%, CARBON
0020	472022		1	RESISTOR, 4.99K OHM, 1/4W, 1%, CARBON
0021	472030		1	RESISTOR, 10K OHM, 1/4W, 1%, CARBON
0022	472049		1	RESISTOR, 49.9K OHM, 1/4W, 1%, CARBON
0023	472058		3	RESISTOR, 100K OHM, 1/4W, 1%, CARBON
0024	472065		1	RESISTOR, 200K OHM, 1/4W, 1%, CARBON
0025	472109		1	RESISTOR, 37.4K OHM, 1/4W, 1%, CARBON
0026	472146		1	RESISTOR, 47.5K OHM, 1/4W, 1%
0027	472140		1	RESISTOR, 332K OHM, 1/4W, 1%
0028	472185		1	RESISTOR, 61.9K OHM, 1/4W, 1%
0029	472270		1	RESISTOR, 1.2M OHM, 1/4W, 1%, METAL FILM
0030	474059		1	RESISTOR, 2 OHM, 1W, 5%
0031	481022		1	DIODE, ZENER, BZY88C12, 12V, 500MW
0032	481530		1	DIODE, KBU4D, 4 AMP, BRIDGE RECTIFIER
0033	481541		1	DIODE, UF4002, 100V, 1A, FAST RECOVERY
0034	481542		2	DIODE, UF5400, 50V, 3A, FAST RECOVERY
0035	484529		1	VOLTAGE REGULATOR, LM78L05ACZ, 5V, 100MA

ITEM	PART NO.	REV.	QPA	DESCRIPTION
0036	484539		1	VOLTAGE REGULATOR, LT1076CT, 2A, STEP-DOWN
0037	485517		1	TRANSISTOR, VN10KM, N-CHANNEL, F.E.T
0038	485527		1	MOSFET, IRF9523, .8 OHMS, 60V, P-CHANNEL
0039	486716		1	LM393N DUAL COMPARATOR
0040	515046		1	FUSE, 2 AMP, 250V, SLO-BLO, IEC127-II
0041	515070		1	FUSE, .800A, .250V, 5 X 20MM, SLO-BLO, IEC127
0042	515503		4	FUSE HOLDER, FOR 5MM FUSES, PC MT
0043	600034		1	RIBBON CABLE ASSY, 4 PIN, 4 INCHES LONG

5673-01 00 REAR PANEL ASSY, OXYPLETH - 520A 18.0.5

LINE	PART NO	REV	QPA	DESCRIPTION
0001	2472-01	00	1	POWER SUPPLY BOARD ASSY, MODEL 520A
0002	4109-10	00	1	P.C. SUPPORT BKT
0003	5229-11	02	1	WIRE CLIP MODIFICATION, LINE CORD
0004	5673-10	00	1	REAR PANEL, MODEL 520A
0005	5673-32	01	1	REAR FACEPLATE, MODEL 520A
0006	5743-10	00	1	POWER ENTRY MODULE, MODEL 520A
0007	5812-10	00	2	SPACER, SUPPORT, OXYPLETH - 520A
0008	9308-11	03	2	CLAMP BUSH, LINE CORD
0011	216059		1	CONNECTOR, PLUG, POTENTIAL COMPENSATION
0013	280188		0	STANDOFF, 3/8 DIA X 3/8 L, 6-32 THD THRU, ALUM
0014	281500		0	4-40 HEXNUT MACHINE SCREW-STEEL CADMIUM
0015	285000		0	#4 WASHER, INTERN TOOTH LOCK WASHER
0016	285001		0	#6 INTERNAL TOOTH LOCK WASHER, STEEL CAD
0017	285013		0	NYL WASH, #4 NATURAL COLOR, .115 ID, .281 OD,
0018	286217		0	SCREW, SLTD BINDING HD, 6-32 X 1 1/4 LG, STL
0019	5819-01	01	1	GROUND WIRE ASSY, 3 1/2 IN. L, OXYPLETH - 520
0020	5820-01	01	1	GROUND WIRE ASSY, 5 1/2 IN. L, OXYPLETH - 520

5719-01 00 FRONT PANEL ASSY, OXYPLETH - 520A 18.0.6

LINE	PART NO	REV	QPA	DESCRIPTION
0001	2473-01	01	1	ALERT BOARD ASSY, MODEL 520A
0002	5676-27	03	1	MEMBRANE KEYPANEL, OXYPLETH - 520A
0003	5720-01	00	1	DISPLAY ASSY, MODEL 520A
0006	280033		0	SPACER #4 X 1/8 CLEARANCE
0007	280187		0	STANDOFF, .187 DIA X 5/8 L, 4-40 F/F THD, ALUM
0008	284200		0	#4-40 X 1/4 SLOTTED BINDING HEAD STEEL
0009	284204		0	#4-40 X 1/2 SLOTTED BINDING HEAD STEEL
0010	285000		0	#4 WASHER, INTERN TOOTH LOCK WASHER, STEEL

2473-01 01 ALERT BOARD ASSY, MODEL 520A 18.0.7

LINE	PART NO	REV	QPA	DESCRIPTION
0001	2473-02	00	1	FAB, ALERT BOARD, MODEL 520A
0002	2473-03	00	0	SCHEMATIC, ALERT BOARD, MODEL 520A
0005	470024		2	RESISTOR, 100 OHM, 1/4W, 10%, CARBON
0006	482565		4	LED, CLEAR, ROUND
0007	600038		1	RIBBON CABLE ASSY, 2 PIN, 7 INCHES LONG

5720-01 00 DISPLAY ASSY, MODEL 520A 18.0.8

LINE	PART NO	REV	QPA	DESCRIPTION
0001	482573		1	LCD MODULE, DOT MATRIX, WITH BACKLIGHT
0002	600033		1	RIBBON CABLE ASSY, 20 PIN, 4 INCHES LONG

5713-01 00 SPEAKER ASSY, OXYPLETH - MODEL 520A 18.0.9

LINE	PART NO	REV	QPA	DESCRIPTION
0001	130010		1	SPEAKER, 8 OHM, 1.50 IN. DIA X .315 HIGH
0002	211225		1	CONNECTOR, 2 PIN, RECEPTACLE, 26AWG, TIN PLAT
0003	605060		0	WIRE, 26AWG, PVC INSULATION, BROWN
0004	608003		0	TUBING, HEAT SHRINK, 1/8 (3.2) DIA, BLACK

5714-01 00 BATTERY HARNESS ASSY, MODEL 520A 18.0.10

LINE	PART NO	REV	QPA	DESCRIPTION
0001	211215		1	CONNECTOR, 2 PIN HOUSING, CLOSED END
0002	216051		0	TERMINAL, RECEPTACLE, INSUL, .187, 22-18AWG,
0003	605154		0	#22 7/30 TC HOOKUP WIRE, 300V, RED
0004	605156		0	#22 7/30 TC HOOKUP WIRE, 300V, BLACK
0005	608001		0	CABLE TIE, .094 X 3.62L, SELF-LKG

5728-01 02 CABLE ASSY, SAO2 INPUT, OXYPLETH - 520A 18.0.11

LINE	PART NO	REV	QPA	DESCRIPTION
0001	5606-16	00	1	DRESS BEZEL, SAO2 INPUT, MODEL 515 & 515A
0002	161007		0	SUPERBONDER 414 ADHESIVE
0003	180009		1	FERRITE SLEEVE, SHIELD, .25(6.35) DIA MAX CAB
0004	211704		1	CONNECTOR, RCPT, 7 PIN, PNL MOUNT
0005	211630		1	CONNECTOR, 6 PIN, RECEPTACLE, SIL, POLARIZED
0006	212102		0	CONTACT, FEMALE, 26-22AWG, CRIMP, GLD PLT

LINE	PART NO	REV	QPA	DESCRIPTION
0007	280108		0	SNAP RIVET
0008	605059		0	WIRE, 26AWG, PVC INSULATION, BLACK
0009	605060		0	WIRE, 26AWG, PVC INSULATION, BROWN
0010	605061		0	WIRE, 26AWG, PVC INSULATION, RED
0011	605063		0	WIRE, 26AWG, PVC INSULATION, YELLOW
0012	605064		0	WIRE, 26AWG, PVC INSULATION, GREEN
0013	605065		0	WIRE, 26AWG, PVC INSULATION, BLUE
0014	608001		0	CABLE TIE, .094 X 3.62L, SELF-LKG
0015	608005		0	TUBING, HEAT SHRINK, 1/16 (1.6) DIA, BLACK
0016	608011		0	TUBING, HEAT SHRINK, 3/16" DIA, BLACK

5765-01 00 TOP COVER ASSY, MODEL 520A 18.0.12

LINE	PART NO	REV	QPA	DESCRIPTION
0001	5765-13	00	1	TOP COVER, PAINTING/SHIELDING, 520A
0002	5827-32	00	1	LABEL, WARNING, EXPLOSION HAZARD, 520A
0003	5828-32	00	1	LABEL, ISOLATION, OXYPLETH - 520A
0004	320012			TAPE, POLYETHELENE, RUBBER RESIN ADH
0004	5823-32	00	1	LABEL, INSTRUCTIONS, OXYPLETH - 520A

5766-01 01 BOTTOM COVER ASSEMBLY, MODEL 520A 18.0.13

LINE	PART NO	REV	QPA	DESCRIPTION
0001	1217-32	02	1	REPAIR LABEL
0002	5409-32	00	1	LABEL, WARNING, POLE MOUNT, MODEL 515
0003	5766-13	00	1	BOTTOM COVER, PAINTING/SHIELDING, 520A
0004	9659-32	00	1	LABEL, BATTERY, MODEL 520A
0005	5826-10	01	4	FOOT PAD, BOTTOM COVER, 520A
0006	315052		1	LABEL, EARTHING SYMBOL
0007	5760-16	00	2	LEFT FOOT, WHITE, KICKSTAND, 520A
0008	5761-16	00	2	RIGHT FOOT, WHITE, KICKSTAND, 520A
0009	4727-10	00	1	KICKSTAND, BEDRAIL
0010	284255			SCREW, 4-40 X 9/16 F.H. SLOTTED
0011	161064			TAPE, 3/4 X 60 YDS, CLEAR, DOUBLE-SIDED ADHES
0012	5405-10	00	1	SHIELD, BATTERY, MODEL 515
0013	5849-10	00	1	BRACKET, SUPPORT, 520A, 1265 & 7100
0014	280124			GROMMET, CONTINUOUS NYLON PNL MT, .037-.105
0015	284264			SCREW, 4-40 X 1/4 L, SLOTTED 82 DEG FLT HD,
0016	161007			SUPERBONDER 414 ADHESIVE

19 Schematic and Assembly Drawings

Drawing	Description
5693-09	Overall Wiring Diagram
2472-01	PSU Board Assy
2472-03	PSU Board Schematic
5693-01	Oximeter Unit Assy
2471-01	Main Board Assy
2471-03	Main Board Schematic
5728-01	Cable Assy, SpO2 Input
2473-03	Alert Lamp Board
5676-27	Keypanel Schematic
5693-00	Main Assy, Model 520A
	Optional Analog Module
9622-01	Analog/RS232 Module
2289-01	Analog/RS232 Bd. Assy
2289-03	Analaog/RS232 Bd. Schematic

Table 8. Schematic and Assembly Drawings

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PM301
POWER ENTRY MODULE
CONFIGURED FOR 120V AC

VOLTAGE SELECTOR

J304

POWER INPUT
100/120V AC
50/60 Hz

L
PE
N

F303
1/2A 250V
SLO-BLO

F304
1/2A 250V
SLO-BLO

S301

BRN
BLU
GRN/YEL

GND

P301 J301

T301

F302
8/10A
SLO-BLO

J302 P302

B5714-01

POWER SUPPLY BD
D2472-03

F301
2A
SLO-BLO

E302

GL301
(INTERIOR)

GL201
BOTTOM COVER

GL303
(EXTERIOR)

GL302
(INTERIOR)

RIGHT ANGLE
MOUNTING BRKT

REAR
PANEL

E1

ISOLATION BARRIER

P102 J102

LS201

B5713-01

P109 J109

J103

F1
1A
SLO-BLO

J104 P104
J105 P105
J107 P107
J106 P106
J108 P108

RS232C/
NOVAMETRIX
ACCESSORIES

J101

F2
100mA
FAST ACTING

MAIN BD
D2471-03

EMI/RFI SHIELDING

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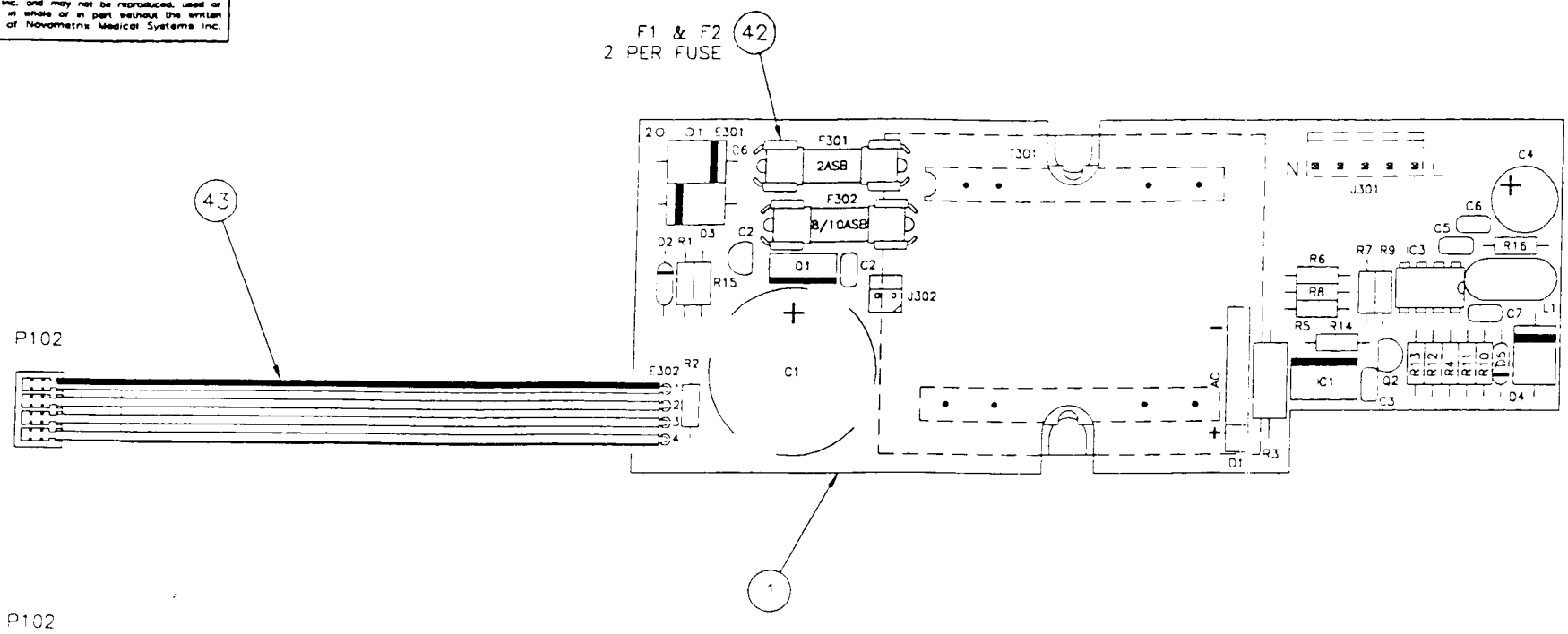

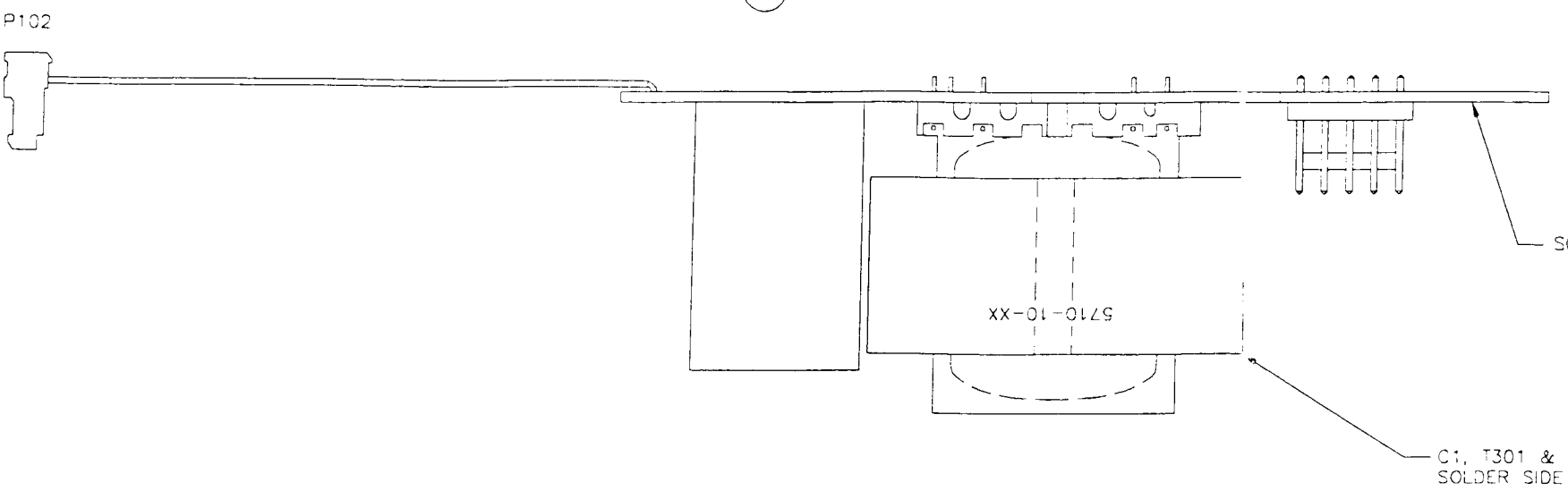

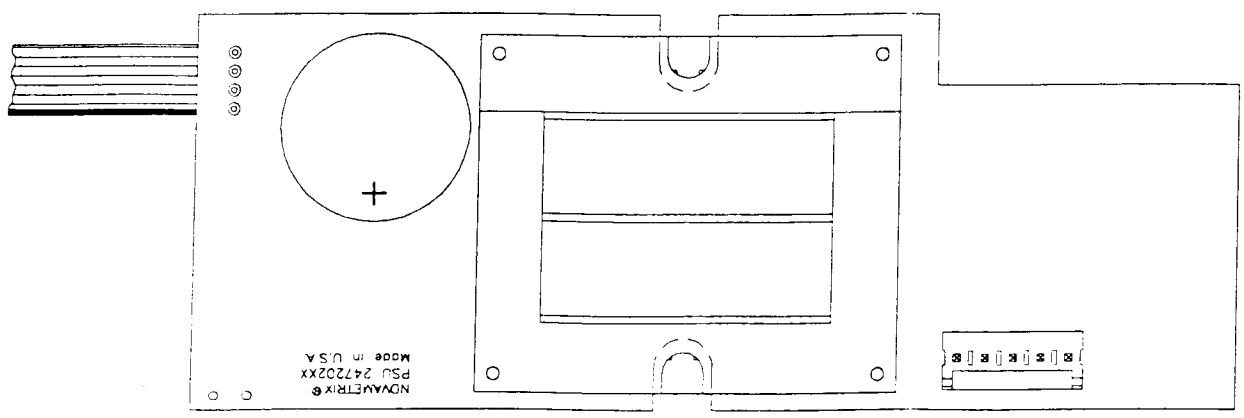

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Isolation Barrier

△ J301

T301

D1 GBU4D

Elect 35V C1 6800uf

Q1 IRF9523

D2 BZY88 C12

C2 .1uf

C3 .1uf

NOTE 3

IC1 LT1076 VIN VSW GND VFB VC

R16 2.21k

C5 .1uf

VCH

△ E301

D6 5400

NOTE 4

200k R1

1.2M R2

FB

R13 61.9k

R14 332k

R12 4.99k

Q2 VN10KM

R11 249

R10 10k

IC3 LM393

△ P102

△ E302

VIN

VBAT

LINEST

DGND

F301 2A Slo-Blo

D3 5400

F302 8/10A Slo-Blo

IC2 78L05 OUT IN GND

R15 150 10%

△ J302

VBAT+

VBAT-

△ NOTES:

1. L R
2. L L
3. C
4. E T

DO NOT SCALE

MATERIAL:

FINISH:

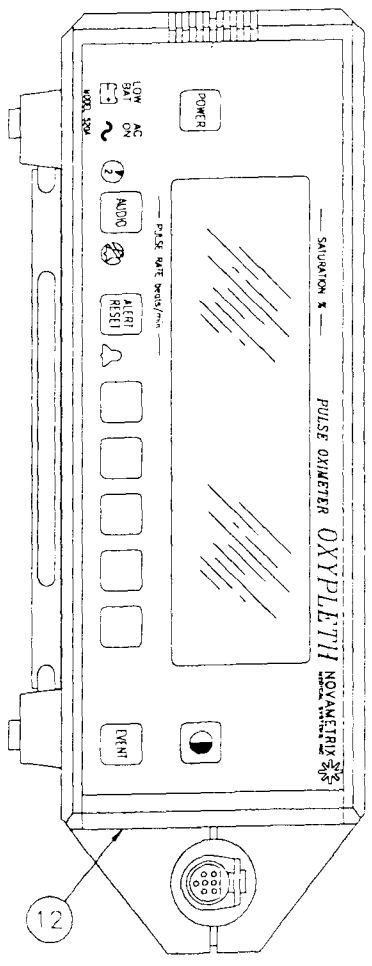
FILE: 2472-83-

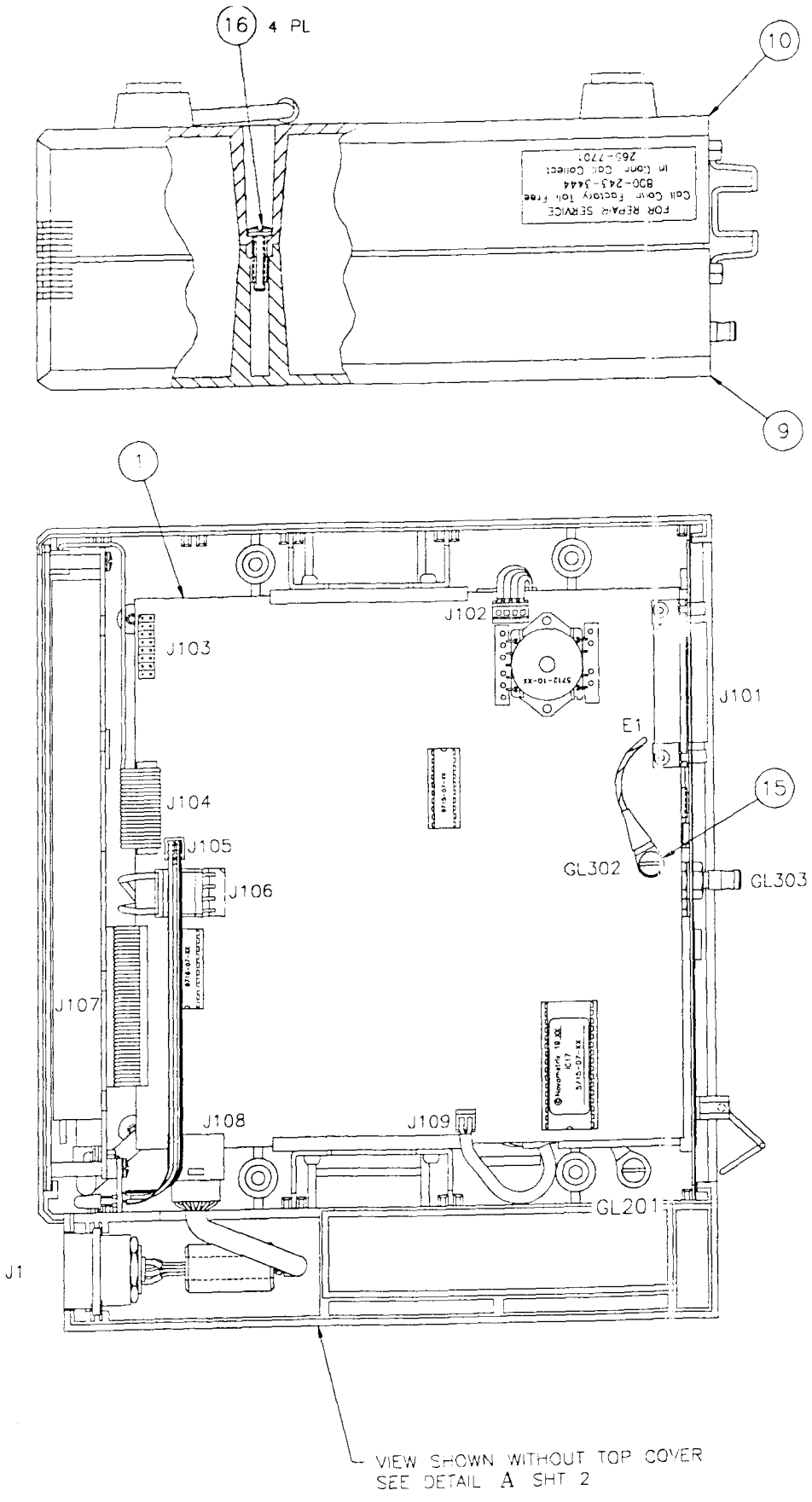
DATE: 4-Jun-92

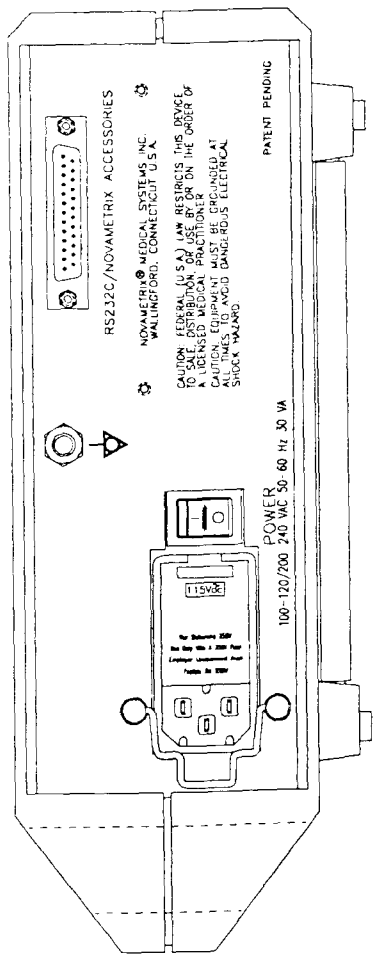
TIME: 12:39:29

REV. ER* NO. BY DATE

disclosed in whole or in part without the written consent of Novametrix Medical Systems Inc.






RS232C/NOVAMETRIX ACCESSORIES
NOVAMETRIX® MEDICAL SYSTEMS, INC.
WALLINGFORD, CONNECTICUT U.S.A.
CAUTION: FEDERAL (U.S.A.) LAW RESTRICTS THIS DEVICE TO SALE, DISTRIBUTION AND USE BY OR ON THE ORDER OF A PHYSICIAN OR PRACTITIONER.
CAUTION: EQUIPMENT MUST BE GROUNDED AT ALL TIMES TO AVOID DANGEROUS ELECTRICAL SHOCK HAZARD.
PATENT PENDING
POWER
100-120/200-240 VAC 50-60 Hz 30 VA
115VAC

NOTES:
1. FOR TEST PROCEDURE SEE A5693-04.

			DO NOT SCALE UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES (mm) BREAK ALL SHARP EDGES TOLERANCES DEC ± .— (mm) .— FRAC ± — (mm) .— HOLES: .007 - .003 (mm) (+.18 - .08) ANG ± —	TITLE: MAIN ASSEMBLY, MODEL 520A	NOVAMETRIX MEDICAL SYSTEMS, INC. WALLINGFORD, CT U.S.A. 06492	
			MATERIAL ——	DRAWN CW 29APR92	CHECKED MRL	SIZE D	DRAWING NO 5693	CODE 01	REV 01
			FINISH ——	MFG ENGR EH 22MAY92	APPROVED AK 22MAY92				
01	N302	26MAY92		USED ON 05693-00		SCALE 1/1		SHEET 1 OF 2	
REV	P.N.O.	DATE							

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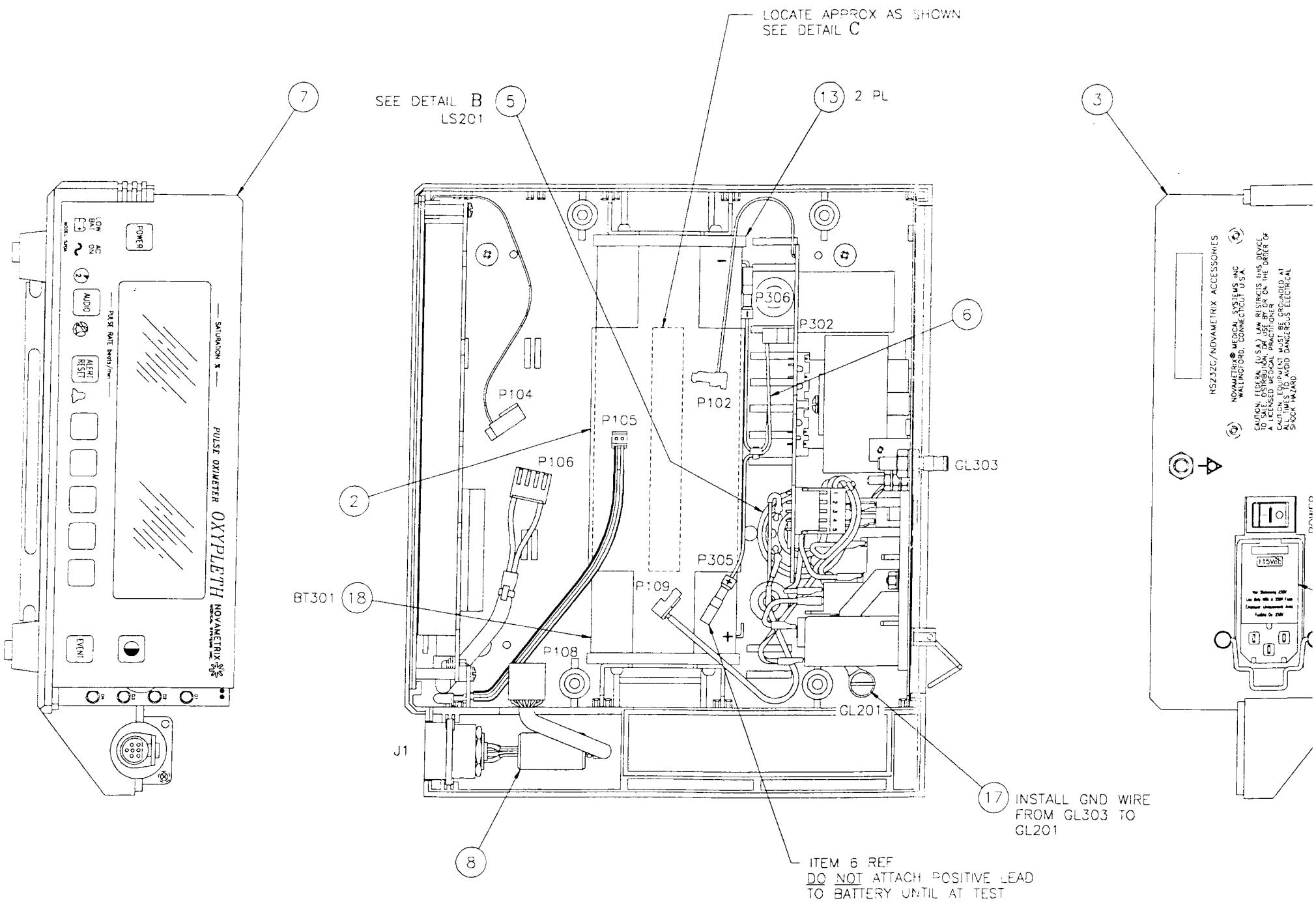

DETAIL A

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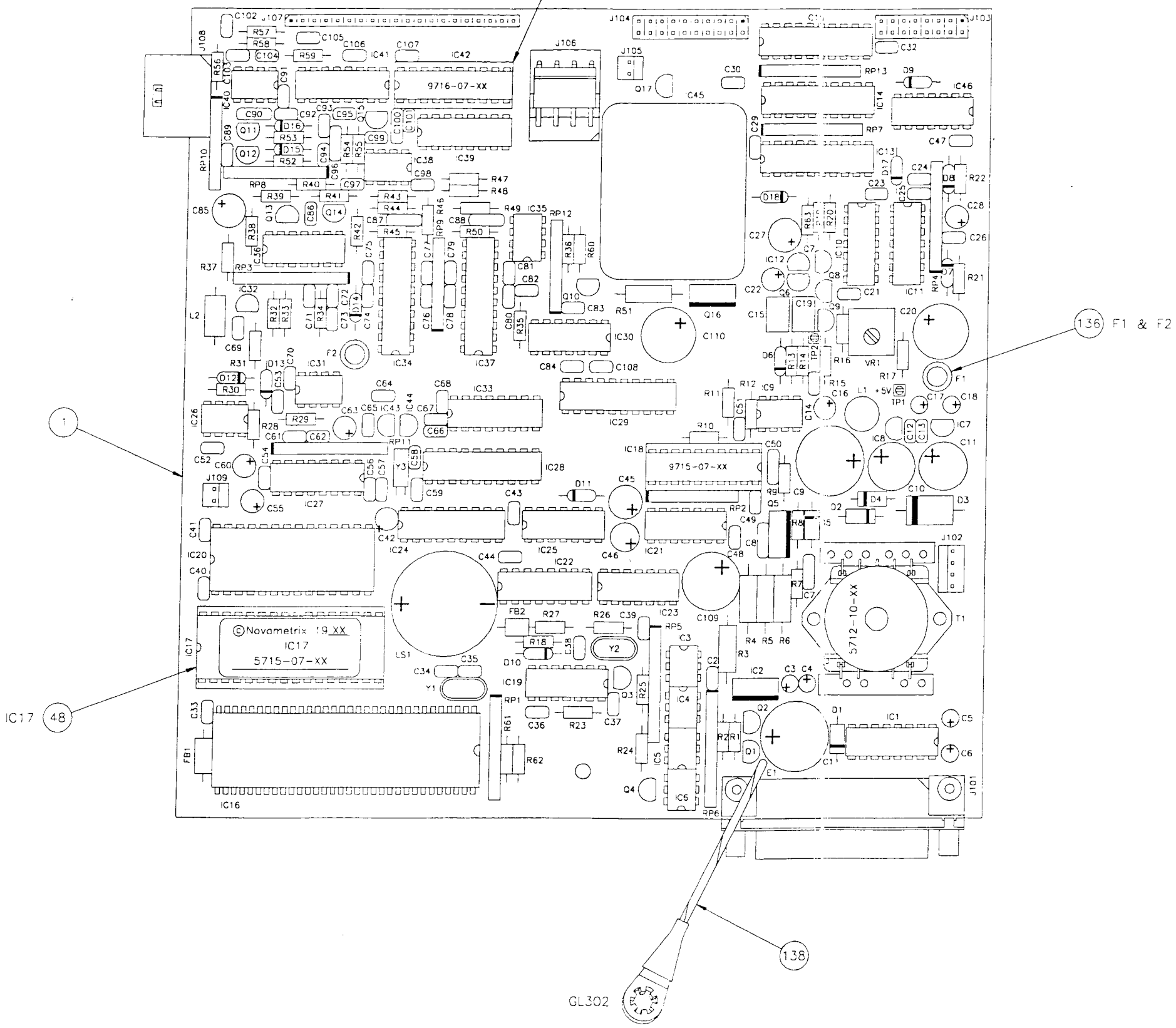

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PN	DESCRIPTION	REF DES
515071	FUSE, 1/10A, 125V, FAST-ACTING, PLUG-IN	F2
515072	FUSE, 1A, 125V, FAST-ACTING, PLUG-IN	F1
5712-10	TRANSFORMER, MAIN BOARD	T1
5711-10	TRANSFORMER, MAIN BOARD	T1 ALTERNATE
5715-07	PROGRAM, EPROM ASSY, Sa02	IC17
9715-07	PROGRAM, PEEL ASSY, CSIO CONTROLLER	IC18
9716-07	PROGRAM, PEEL ASSY, TIMING SEQUENCER	IC42
481031	DIODE, ZENER, BZX79-C7V5, 7.5V, 500mW	D12
481501	DIODE, 1N4148, SILICON	D6-D11, D14-D16, D18
481534	DIODE, SCHOTTKY, BAT82, MINIATURE, DO-34	D13, D17
481541	DIODE, UF4002, 100V, 1A, FAST RECOVERY	D1, D2, D4, D5
481542	DIODE, UF5400, 50V, 3A, FAST RECOVERY	D3
230006	CRYSTAL, 3.2768M Hz	Y2
230016	CRYSTAL, 32.768k Hz	Y3
230018	CRYSTAL, 12.288M Hz	Y1
216029	TEST POINT	TP1, TP2

PN	DESCRIPTION	REF DES
483002	TRANSISTOR, 2N3906, PNP, SILICON	Q10
483017	TRANSISTOR, BC214C, PNP, SILICON	Q1-Q4
484014	TRANSISTOR, ZTX109C, NPN	Q9
485520	TRANSISTOR, MOSFET, BS250, P-CHANNEL	Q6, Q8
485527	TRANSISTOR, MOSFET, IRF9523, 60V, P-CHANNEL	Q16
485529	TRANSISTOR, VN0610L, N-CHAN ENHANCEMENT	Q7, Q11-Q15, Q17
485531	TRANSISTOR, SMP30N10, N-CHAN ENHANCEMENT	Q5
400035	IC, DC TO AC INVERTER, 5VDC INPUT	IC45
484515	VOLTAGE REGULATOR, LM317LZ, POSITIVE, ADJ	IC32
484523	VOLTAGE REGULATOR, LM79L05ACZ, 100mA, NEG	IC43
484529	VOLTAGE REGULATOR, LM78L05ACZ, +5V, 100mA	IC44
484531	VOLTAGE REGULATOR, 78M05CKC, +5V, 500mA	IC2
484533	VOLTAGE REGULATOR, LP2950ACZ-5.0, ADJ	IC12
484534	VOLTAGE REGULATOR, LM79L12ACZ, -12V DC	IC8
484535	VOLTAGE REGULATOR, LM78L12ACZ, +12V DC	IC7
486256	IC, HM62256LP-12, 32k STATIC RAM	IC20
486268	IC, DG444DJ, SPST CMOS ANALOG SW, 4 CHAN	IC41
486276	IC, DS232CPE, DUAL RS232C RCVR/XMITTER	IC1
486285	IC, HID64180R1P6, 8 BIT MPU, HI INTEGRATION	IC16
486295	IC, MM74HC4051N, 8-CHAN ANALOG MULTIPLXR	IC33
486298	IC, MM74HC4020N, 14-STAGE BINARY COUNTER	IC39
486299	IC, CS5503-JD-EP, 20-BIT A TO D CONVERTER	IC34, IC37
485300	IC, TLC549IP, 8-BIT CONVERTER, SERIAL CNTRL	IC31
486305	IC, MSM6242BRS, REAL TIME CLOCK/CALENDAR	IC24
486600	IC, CD4013B, DUAL D-TYPE FLIP FLOP	IC10
486606	IC, CD4093BE, QUAD 2 INPUT NAND GATE	IC11
486625	IC, MC74HC32N, QUAD 2 INPUT OR GATE	IC23, IC25, IC46
486651	IC, MM74HC138, 3 TO 8 LINE DECODER	IC22
486675	IC, MM74HC14N, CMOS	IC19, IC21
486680	IC, MM74HC573N, CMOS	IC13-IC15, IC28
486685	IC, AD7528JN, CMOS INTERFACE	IC29
486712	IC, TL074CN, QUAD F FET, LOW OFFSET	IC30, IC36
487053	IC, AD712JN, DUAL BIFET OP AMPLIFIER	IC38
487061	IC, TBA820M, MONOLITHIC INT AUDIO AMP, 2W	IC26
487064	IC, CNY17-III, PHOTON COUPLED ISOLATOR	IC3-IC6
487065	IC, UC3843N, CURRENT MODE PWM CONTROLLER	IC9
487069	IC, LT1019CN8-2.5, 16V VOLTAGE REFERENCE	IC35
486255	IC, SN76496AN, PROGRAMMABLE TONE GENERATOR	IC27
486791	IC, TLE2022CP, DUAL HI SPD OP AMP, LOW PWR	IC40

PN	DESCRIPTION	REF
470025	RESISTOR, 120 OHM, 1/4W, ±10%	R7
470111	RESISTOR, 33 OHM, 1/2W, ±10%, METAL FILM	R4-R6
471400	RESISTOR, 100M OHM, 1W, ±5%	R3
472003	RESISTOR, 100 OHM, 1/4W, ±1%	R18, R27, R59
472007	RESISTOR, 475 OHM, 1/4W, ±1%	R1, R2, R20,
472011	RESISTOR, 1k OHM, 1/4W, ±1%	R8, R9, R15,
472021	RESISTOR, 4.75k OHM, 1/4W, ±1%	R16
472030	RESISTOR, 10k OHM, 1/4W, ±1%	R22, R29, R30
472034	RESISTOR, 12.1k OHM, 1/4W, ±1%	R19
472037	RESISTOR, 13.7k OHM, 1/4W, ±1%	R45, R50
472041	RESISTOR, 20k OHM, 1/4W, ±1%	R37, R38
472058	RESISTOR, 100k OHM, 1/4W, ±1%	R33, R43, R44
472063	RESISTOR, 162k OHM, 1/4W, ±1%	R32
472067	RESISTOR, 221k OHM, 1/4W, ±1%	R12
472105	RESISTOR, 3.92k OHM, 1/4W, ±1%	R54, R55
472121	RESISTOR, 3.74k OHM, 1/4W, ±1%	R17
472146	RESISTOR, 47.5k OHM, 1/4W, ±1%	R21
472170	RESISTOR, 22.1k OHM, 1/4W, ±1%	R10
472193	RESISTOR, 23.7k OHM, 1/4W, ±1%	R36
472195	RESISTOR, 41.2k OHM, 1/4W, ±1%	R46-R49
472198	RESISTOR, 3.3 OHM, 1/4W, ±1%	R53
472200	RESISTOR, 5.6 OHM, 1/4W, ±1%	R52
472204	RESISTOR, 1 OHM, 1/4W, ±1%	R28
472227	RESISTOR, 47 OHM, 1/4W, ±1%, METAL FILM	R14, R35
472246	RESISTOR, 66.5k OHM, 1/4W, ±1%, METAL FILM	R40, R42
472267	RESISTOR, 22 OHM, 1/4W, ±1%, METAL FILM	R11
472268	RESISTOR, 8.66k OHM, 1/4W, ±1%, METAL FILM	R13
472272	RESISTOR, 59k OHM, 1/4W, ±1%	R23
472274	RESISTOR, 26.7 OHM, 1/4W, ±1%	R31
472276	RESISTOR, 6.49k OHM, 1/4W, ±1%	R39, R41
474032	RESISTOR, 10 OHM, 1/2W, ±5%	R51
474089	RESISTOR PACK, 100k OHM, ±2%, 8 BUS RES	RP1, RP7, RP13
474098	RESISTOR PACK, 100k OHM, ±2%, 5 ISOL RES	RP3-RP6
474131	RESISTOR PACK, 10k OHM, ±2%, 5 BUS RES	RP2
474132	RESISTOR PACK, 41k OHM, ±2%, 4 ISOL RES	RP10, RP12
474133	RESISTOR PACK, 10 OHM, ±2%, 4 ISOL RES	RP9
474134	RESISTOR PACK, 41k OHM, ±2%, 8 BUS RES	RP8
474135	RESISTOR PACK, 100 OHM, ±2%, 5 ISOL RES	RP11
475034	POTENTIOMETER, 2k OHM, ±10%, 1 T, TOP ADJ	VR1

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DATA BUS
ADDRESS BUS
CONTROL BUS

IC24
MSM6242
Real-Time CLK
Y3
32.768KHz
C57 22p
C59 22p
VBACK
Tant. 35V
C42 2.2uf
VCC
RP2 10k
RP2 10k

IC27
NCR8496PT
Tone Controller
AUD_CLK
WAIT*
VCC C56 0.1u
C61 .1uF
C52 0.1u
AUDIO OUT
AUDIO IN
RP11 100
R30 10k
C62 .01u
IC26
TBA820M
C55 100u
6.3V Elect
C54 .01u
C60 47u 10V Elect
C63 100u 6.3V Elect
R28 1
C53 .22u Cer.
LS1
Speaker

DSPBR
IC19
74HC14
DREQ*
R23 59k
R18 100
D10 1N4148
C36 .001uf 5%
△ This supply connects back to switcher +5V.
R51 10 1/2W
Q16 IRF9523
Elect. 16V
C110 1000uf
IC45
E1166
J106
CCD+
CCD-
△ This point connects back to switcher gnd.

VCC
C108 .1uf
IC29
AD7528
D TRANS LATCHES
IC30
TL074
RP12 41.0k
+V12
-V12
C83 .1uf
C84 .1uf
C29 .1uf
IC13
74HC573
LPORT
CAL
TML
AOL
ARL
KJL*
BTL
DSPBR
OFFDIS
SNDOUT
RDKEY1
IC14
RP7 100k
RDKEY_2*
IC15
RP13 100K

REV	"R" NO.	BY	DATE

DO NOT SCAL
UNLESS OTHERWISE SP
DIMENSIONS ARE IN IN
BREAK ALL SHARP
MATERIAL :
FINISH :
FILE : 520Icc
DATE : 1-May-9
TIME : 09:23:50

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DATA BUS

ADDRESS BUS

CONTROL B

8-bit Micro Computer

△ NOTES:
1.) UNLESS OTHERWISE SPECIFIED: RESISTANCE VALUES ARE IN OHMS, 1/4W, 1%
2.) LAST REFERENCE DESIGNATOR USED: C110, D18, F2, FB2, IC46, J109, L2, Q17, R63, RP13, T1, TP2, VR1, Y3.
3.) NOT USED ON THIS ASSEMBLY: J103, LS1

△ SPARES

DO NOT SCAL
UNLESS OTHERWISE SP
DIMENSIONS ARE IN IN
BREAK ALL SHARP

MATERIAL:

FINISH:

FILE: 520ica
DATE: 1-May-9
TIME: 09:02:45

REV.	"R" NO.	BY	DATE

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CONTROL BUS

+V12 R35 47 LT1019CN8-2.5 IC35 In Out Gnd 2.5VREF C82 .1uf

IC44 78L05 +VA IN OUT GND +V5 C66 .1uf C67 .1uf

C65 .1uf C64 .1uf -V12 79L05 IN OUT GND -V5 IC43

2.5VREF CSADC1* SDATA CLKS SC2 CAL SC1 CLKSEQ

IC37 CS5503 +V5 -V5 C79 .1uf C78 .1uf C88 .1uf Poly C81 .1uf C80 .1uf RP9 10

IC34 CS5503 +V5 -V5 C75 .1uf C74 .1uf C87 .1uf Poly C77 .1uf C76 .1uf RP9 10

CSADC2* 2.5VREF

R49 41.2k R50 13.7k R46 41.2k R45 13.7k

IC38 AD712JN R55 3.92k C96 .1uf Poly R43 100k R48 41.2k IC41 DG444

IC40 AD712JN

IC38 AD712JN R54 3.92k C100 .1uf Poly R44 100k R47 41.2k DG444 IC41

Q15 VN0610L

VLED R37 20k R38 20k

AUD CLK

IC39 14-BIT BIN COUNTER RESET CLKSEQ CLR CLK Q1 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13 Q14 4020

IC42 18CV8 PEEL CLK D0 D1 D2 D3 D4 D5 D6 SC1 I/O SC2 SC1 9

19 INSIC* 18 RDLED* 17 IRLED* 16 SIGND* 15 ASAMP* 14 SYNC 13 ISMP* 12 RDSMP* 11 SC2

INT5MS SC1 SC2 SYNC

+VA -V5

CSADC3* SDATA CLKS C70 .1uf +V5 IC31 TLC549I /CS VCC DOUT CLK AIN REF- GND REF+ R29 10k D13 BAT85

VCC 8CHAN ANALOG MUX/DMUX IC33 HC4051 VCC GND INH VEE A B C Out/In I0 I1 I2 I3 I4 I5 I6 I7 C68 .1uf

A0AUX A1AUX A2AUX ADCV12 ADCAUX1 FE DC LEDPWR INC PRB IRLED BAT RDLED

+V12 RP3 100k RP8 41.0k

4VREF IC36 TL074 2.5VREF VBAT RP3 100k R33 100k R32 162k

R42 66.5k C72 .0047uf RP3 100k R34 1k D14 4148 C73 1uf RP10 41.0k IC36 TL074

REV.	"R" NO.	BY	DATE

DO NOT SCAL
UNLESS OTHERWISE SP
DIMENSIONS ARE IN IN
BREAK ALL SHARP

MATERIAL:

FINISH:

FILE: 5201cb
DATE: 1-May-9
TIME: 09:18:16

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IC CHART

REF DES	TYPE NO.		POWER													DEDICOUPLING CAP (.1uF)
		VCC	VCCI	VBACK	V IN	+VI	+V5	+V12	+VA	-V5	-V12	-VA	A GND	D GND	I GND	
IC1	DS232CPE	–	16	–	–	–	–	–	–	–	–	–	–	–	15	C2 TO I GND
IC2	78M05CKC	–	OUT	–	–	N	–	–	–	–	–	–	–	–	GND	NONE
IC3	CNY17-III	–	–	–	–	–	–	–	–	–	–	–	–	–	–	NONE
IC4	CNY17-III	–	–	–	–	–	–	–	–	–	–	–	–	–	–	NONE
C5	CNY17-III	–	–	–	–	–	–	–	–	–	–	–	–	–	–	NONE
IC6	CNY17-III	–	–	–	–	–	–	–	–	–	–	–	–	–	–	NONE
IC7	LM78L12ACZ	–	–	–	–	–	–	OUT	IN	–	–	–	GND	–	–	C13 TO A GND
IC8	LM79L12ACZ	–	–	–	–	–	–	–	–	–	OUT	N	GND	–	–	C12 TO A GND
C9	UC3843N	–	–	–	7 ⚠4	–	–	–	–	–	–	–	–	5	–	C16 TO D GND (47uF)
IC10	CD4013B	–	–	14		–	–	–	–	–	–	–	–	7	–	C23 TO D GND
IC11	CD4093BE	–	–	14		–	–	–	–	–	–	–	–	7	–	C25 TO D GND
IC12	LP2950ACZ	–	–	OUT	IN	–	–	–	–	–	–	–	–	GND	–	C22 TO D GND (2.2uF)
IC13	MM74HC573N	20	–	–	–	–	–	–	–	–	–	–	–	10	–	C29 TO D GND
IC14	MM74HC573N	20	–	–	–	–	–	–	–	–	–	–	–	10	–	C30 TO D GND
IC15	MM74HC573N	20	–	–	–	–	–	–	–	–	–	–	–	10	–	NONE
IC16	HI0641801R1P6	33	–	–	–	–	–	–	–	–	–	–	–	1, 33	–	C33 TO D GND
IC17 ⚠1	HN27C101G-17	32	–	–	–	–	–	–	–	–	–	–	–	16	–	C40 TO D GND
IC18 ⚠2	PEEL18CV8	20	–	–	–	–	–	–	–	–	–	–	–	10	–	C49 TO D GND
IC19	MM74HC14N	14	–	–	–	–	–	–	–	–	–	–	–	7	–	C37 TO D GND
IC20	HM62256LP-12	–	–	28	–	–	–	–	–	–	–	–	–	14	–	C41 TO D GND
IC21	MM74HC14N	14	–	–	–	–	–	–	–	–	–	–	–	7	–	C48 TO D GND
IC22	MM74HC138	16	–	–	–	–	–	–	–	–	–	–	–	8	–	C44 TO D GND
IC23	MC74HC32N	14	–	–	–	–	–	–	–	–	–	–	–	7	–	NONE
IC24	MSM6242BRS	–	–	18	–	–	–	–	–	–	–	–	–	9	–	C42 TO D GND (2.2uF)
IC25	MC74HC32N	–	–	14	–	–	–	–	–	–	–	–	–	7	–	C43 TO D GND
IC26	TBA820M	6	–	–	–	–	–	–	–	–	–	–	–	4	–	C52 TO D GND
IC27	SN76496AN	16	–	–	–	–	–	–	–	–	–	–	–	8	–	C56 TO D GND
IC28	MM74HC573N	20	–	–	–	–	–	–	–	–	–	–	–	10	–	C58 TO D GND
C29	AD7528JN	17	–	–	–	–	–	–	–	–	–	–	+	5	–	C108 TO D GND
IC30	TL074CN	–	–	–	–	–	–	4	–	–	11	–	–	–	–	C83 TO A GND C84 TO A GND
IC31	TLC5491P	–	–	–	–	–	8	–	–	–	–	–	4	–	–	C70 TO A GND
IC32	LM317LZ	–	–	–	–	–	–	–	IN	–	–	–	–	–	–	NONE
IC33	MM74HC4051N	16	–	–	–	–	–	–	–	7	–		–	8	–	C68 TO D GND
IC34	CS5503JP	–	–	–	–	–	14 15 ⚠4 	–	–	 6 ⚠4 7	–	–	8 	5 	–	C75 TO D GND C74 TO D GND C76 TO D GND C77 TO D GND
IC35	LT1019CN8-2.5	–	–	–	–	–	–	2 ⚠4	–	–	–	–	4	–	–	C82 TO A GND
IC36	TL074CN	–	–	–	–	–	–	4	–	–	11	–	–	–	–	C71 TO A GND C86 TO A GND
IC37	CS5503JP	–	–	–	–	–	14 15 ⚠4 	–	–	 6 ⚠4 7	–	–	8 	5 	–	C79 TO D GND C78 TO D GND C80 TO D GND C81 TO D GND
IC38	AD712JN	–	–	–	–	–	–	8	–	–	4	–	–	–	–	C98 TO A GND C99 TO A GND
IC39	MM74HC4020N	16	–	–	–	–	–	–	–	–	–	–	–	8	–	C101 TO D GND
IC40	TLE2022CP	–	–	–	–	–	–	8	–	–	4	–	–	–	–	C91 C102
IC41	DG444DJ	12	–	–	–	–	–	13	–	–	4	–	5	–	–	C93 TO A GND C106 TO A GND
IC42 ⚠3	PEEL18CV8	20	–	–	–	–	–	–	–	–	–	–	–	10	–	C107 TO D GND
IC43	LM79L05ACZ	–	–	–	–	–	–	–	–	OUT	–	IN	GND	–	–	C65 TO A GND
IC44	LM78L05ACZ	–	–	–	–	–	OUT	–	IN	–	–	–	GND	–	–	C66 TO A GND
IC45	E1166	1	–	–	–	–	–	–	–	–	–	–	2	–	–	C110 TO A GND (1000uF)
IC46	MC74HC32N	14	–	–	–	–	–	–	–	–	–	–	–	7	–	C47 TO D GND

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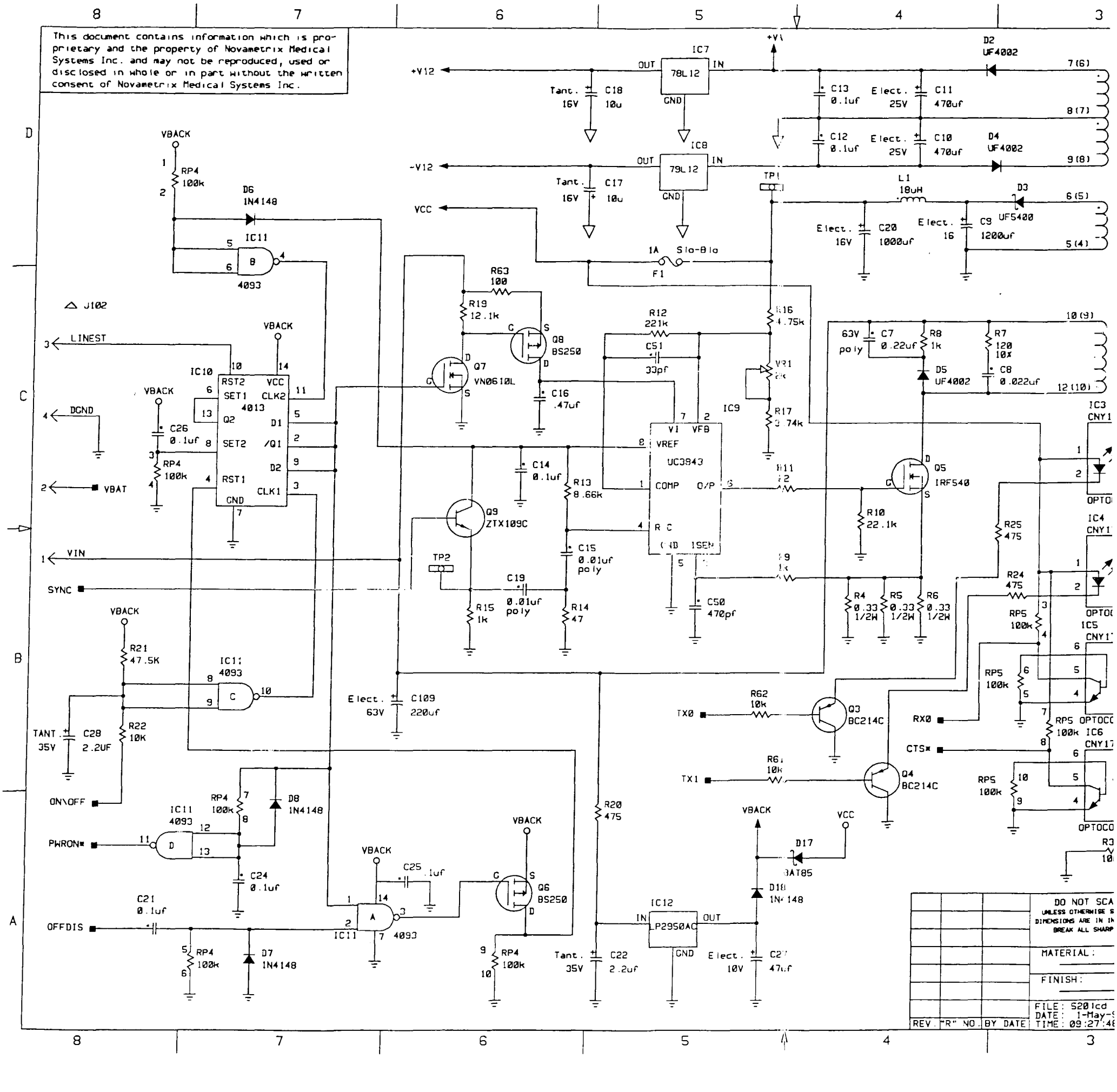

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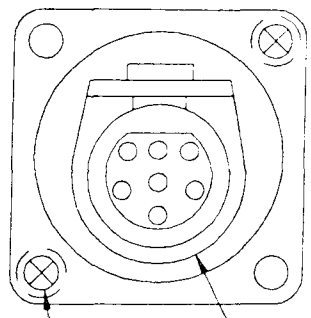
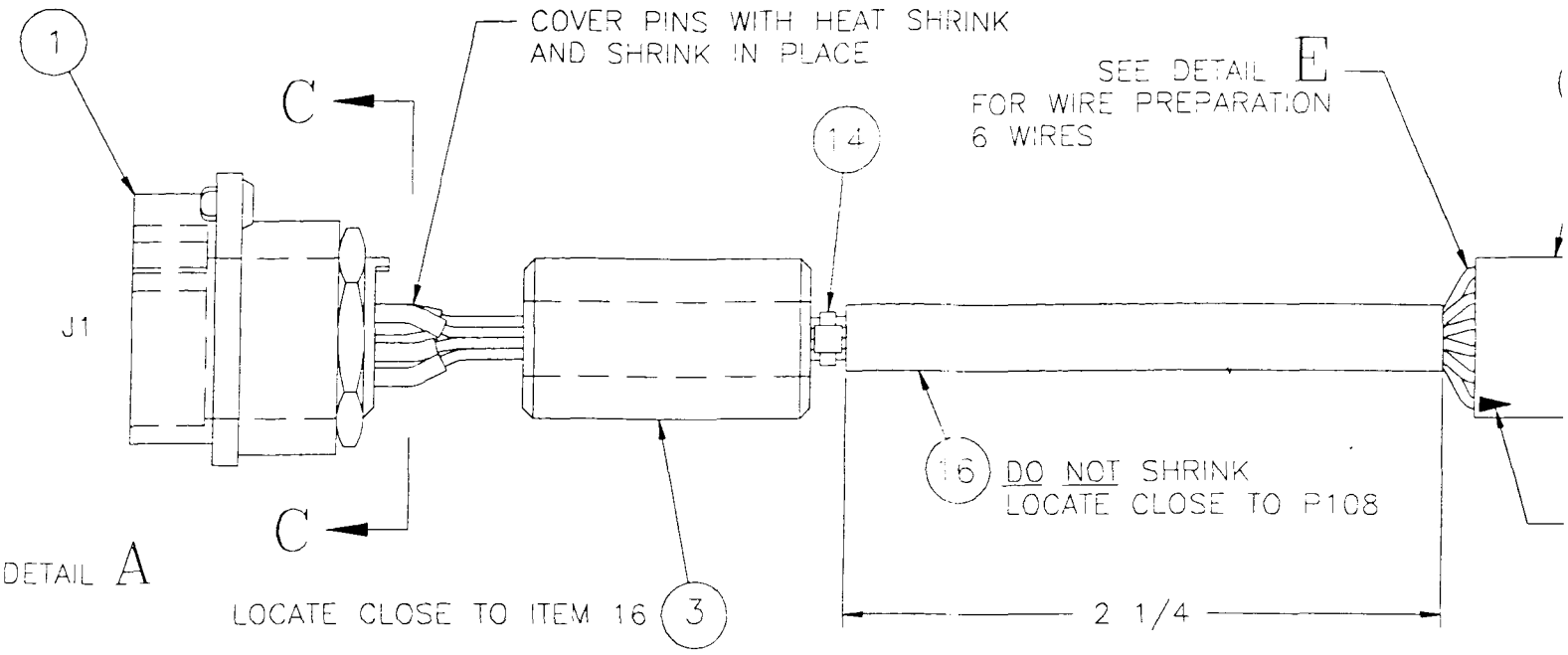
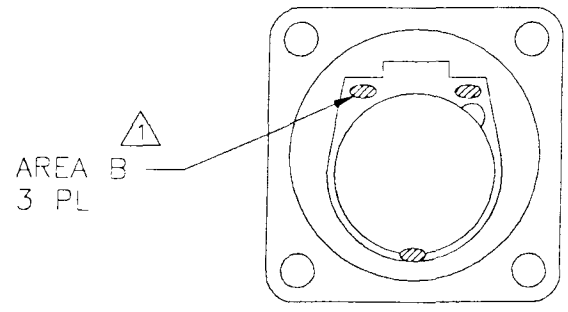
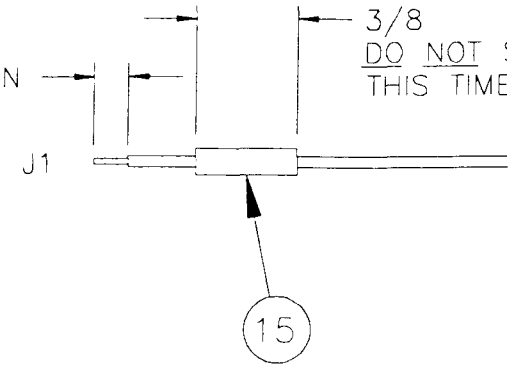






DETAIL A



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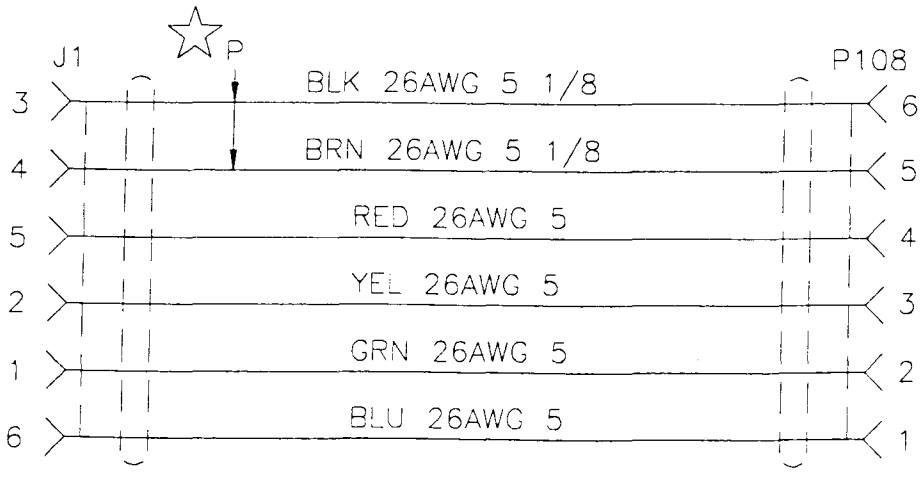
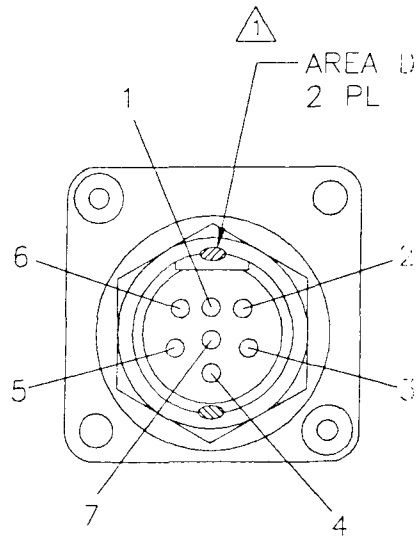


OVERALL WIRING DIAGRAM

☆ TWIST BLACK & BROWN WIRES 6 TURNS CLOCKWISE.



REAR VIEW C – C

NOTES:

1. BEFORE ASSEMBLING IT ITEM 2 TO DRESS BEZ AND TO AREA D IN RE ONTO CONNECTOR UNT ALLOW ASSY TO CURE

REV	R NO.	DATE	
			DO NOT SCALE UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES (mm) BREAK ALL SHARP EDGES
			TOLERANCES
			DEC ± ——— (mm) ———
			FRAC ± 1/16 (mm) ———
			HOLES +.007 −.003 (mm) (+.18 −.08)
			ANG ± ———
			MATERIAL ———
02	N302	26MAY92	
01	N299	26MAR92	FINISH ———

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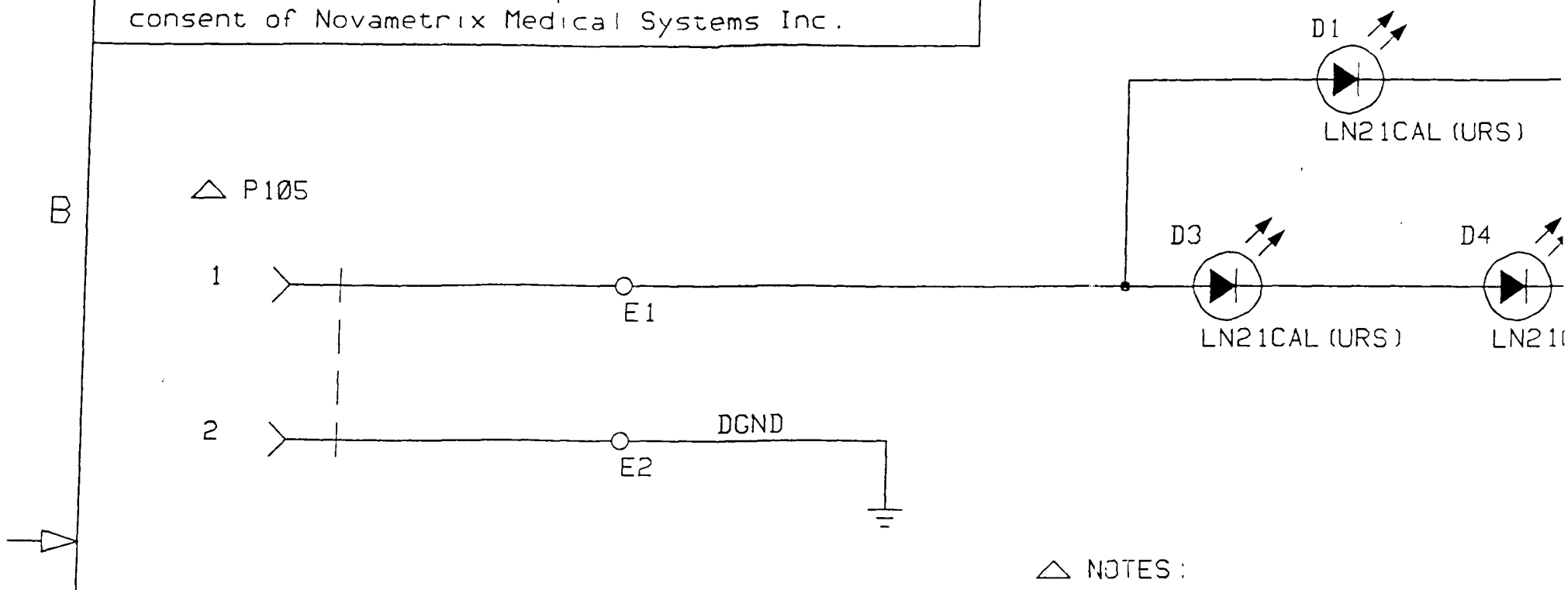

△ NOTES:
1.) UNLESS OTHERWISE SPECIFI
RESISTANCE VALUES ARE IN OHM
2.) LAST REFERENCE DESIGNATO
R2, D4, E2
3.) R1 AND R2 LOCATED ON ARTI
OF BOARD

REV.	"R" NO.	BY DATE

DO NOT SCALE
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES (mm)
BREAK ALL SHARP EDGES

MATERIAL:

FINISH:

SCHEMATIC,
ALERT LAMP BOARD
MODEL 520A

DRAWN	CHECKED
Tony Esposito 1-May-92	
MFG. ENGR	APPROVED

USED ON MODEL 520A 12:09:19

Wa

SIZE B

247

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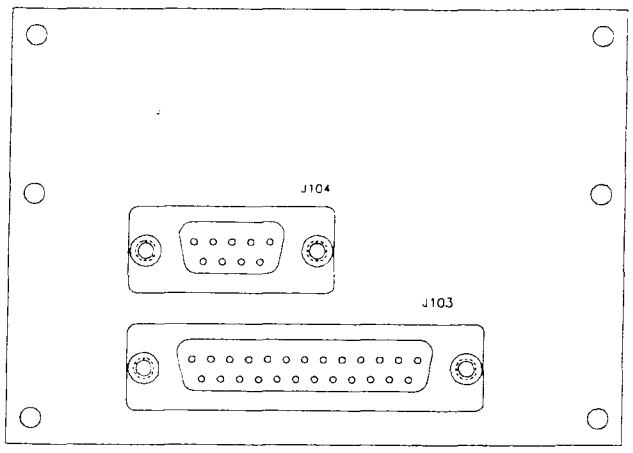

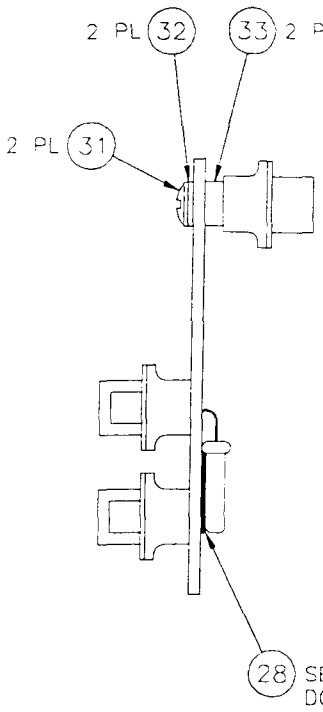

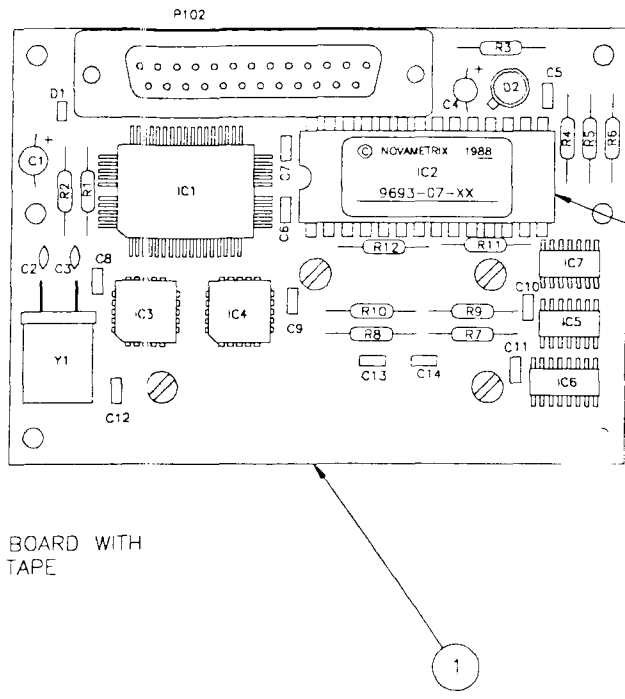

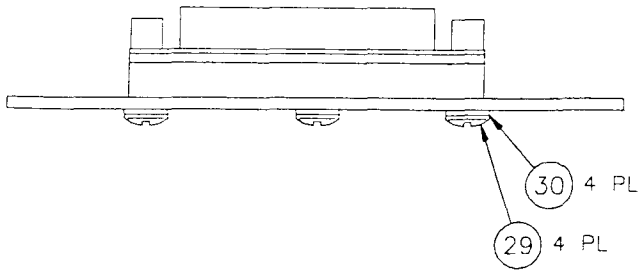

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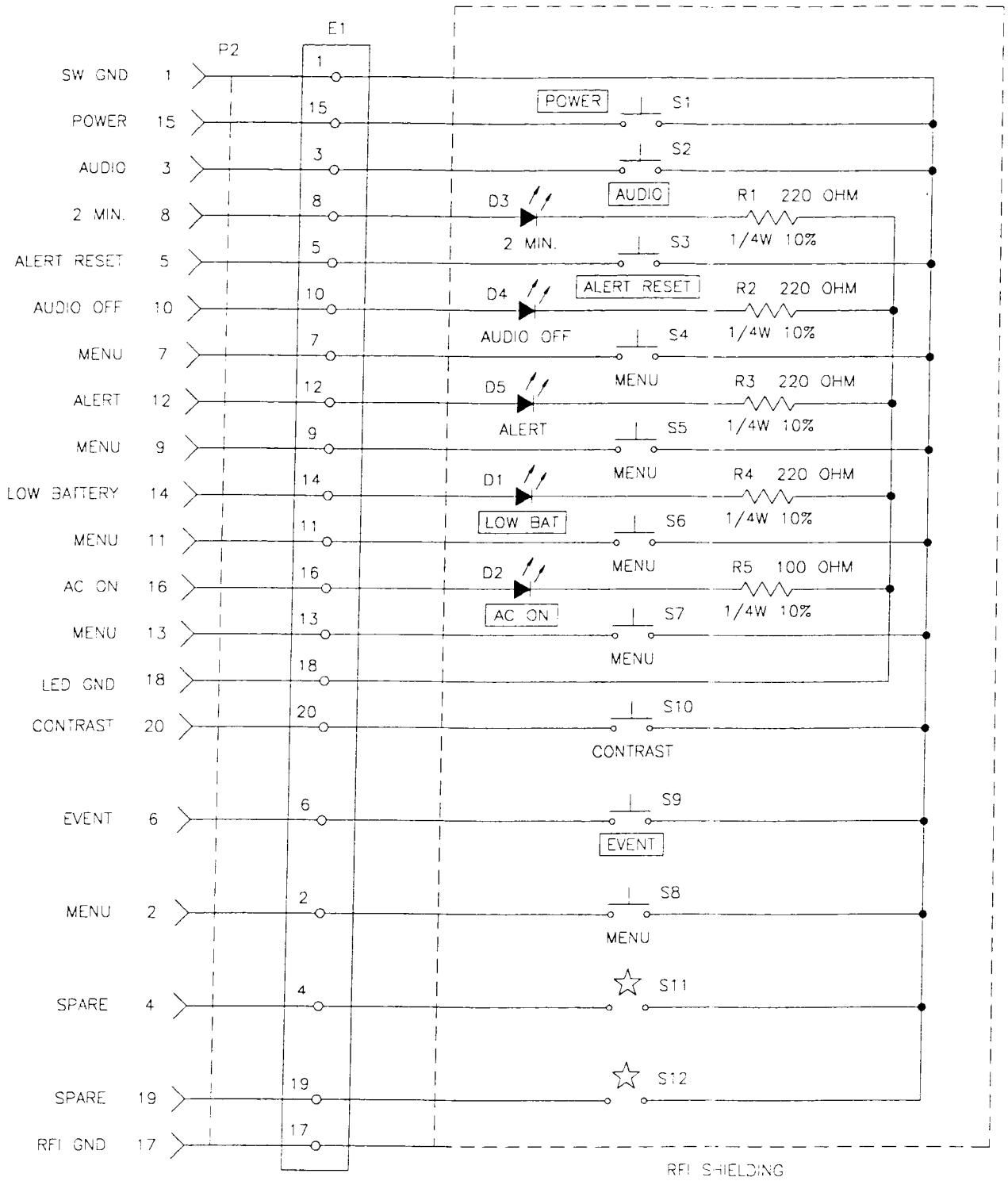

SCHEMATIC DIAGRAM

☆ S11 & S12 ARE ALLOWED FOR IN THE CIRCUITRY BUT ARE NOT USED FOR THIS KEYPANEL.

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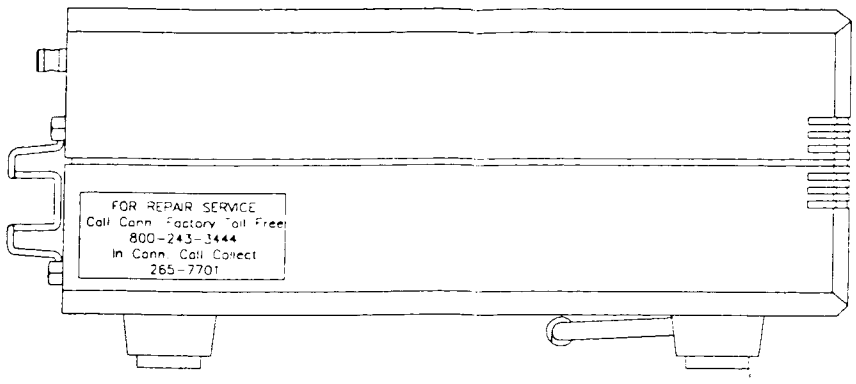
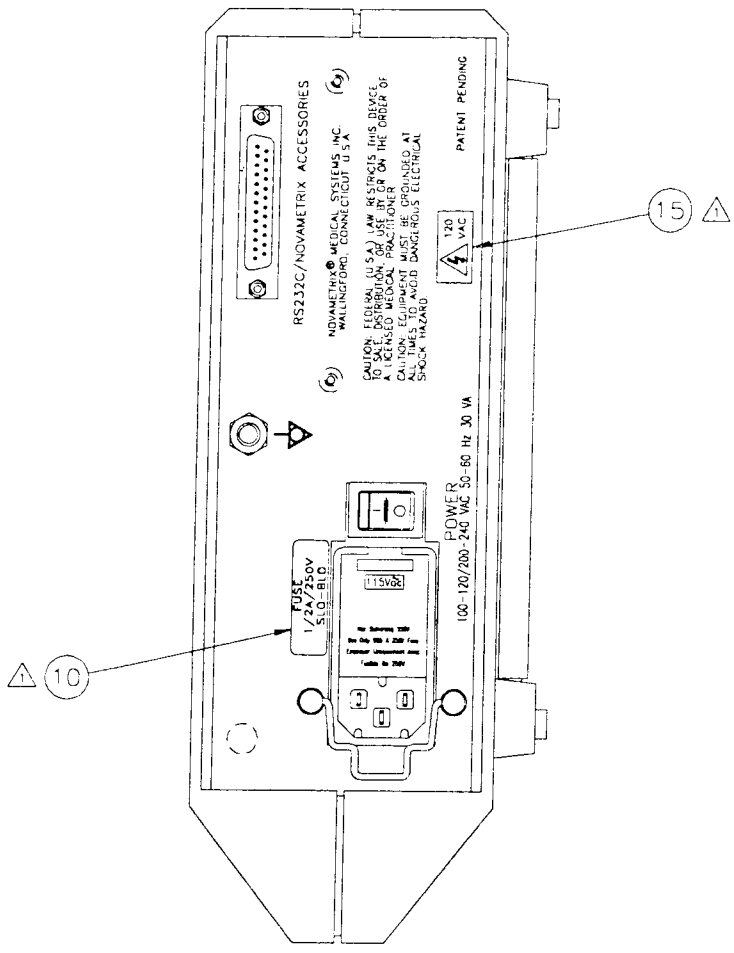
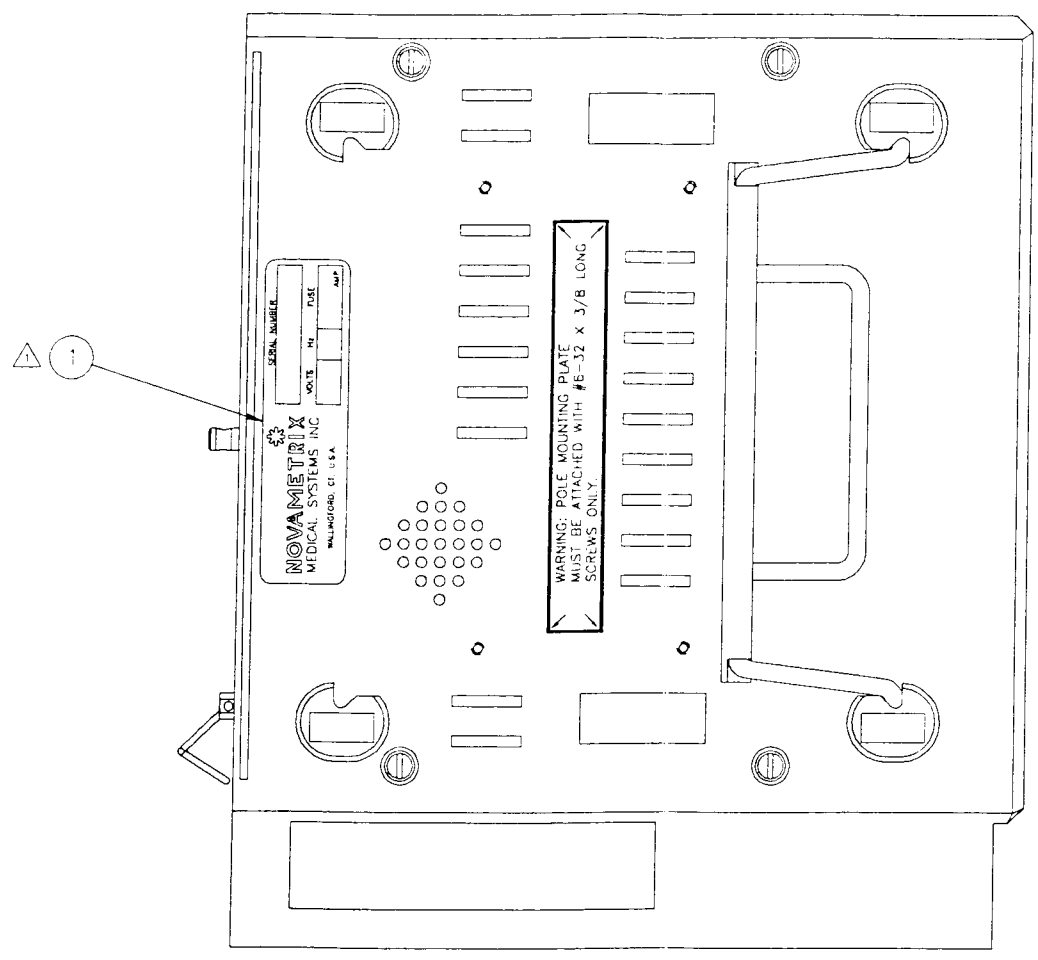
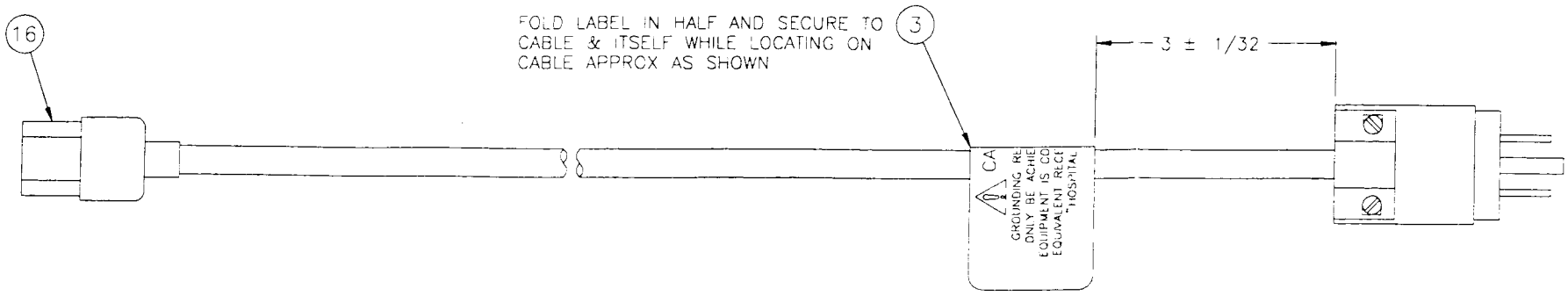
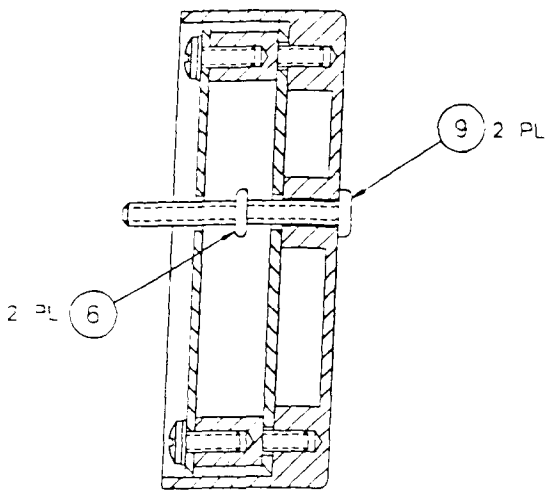


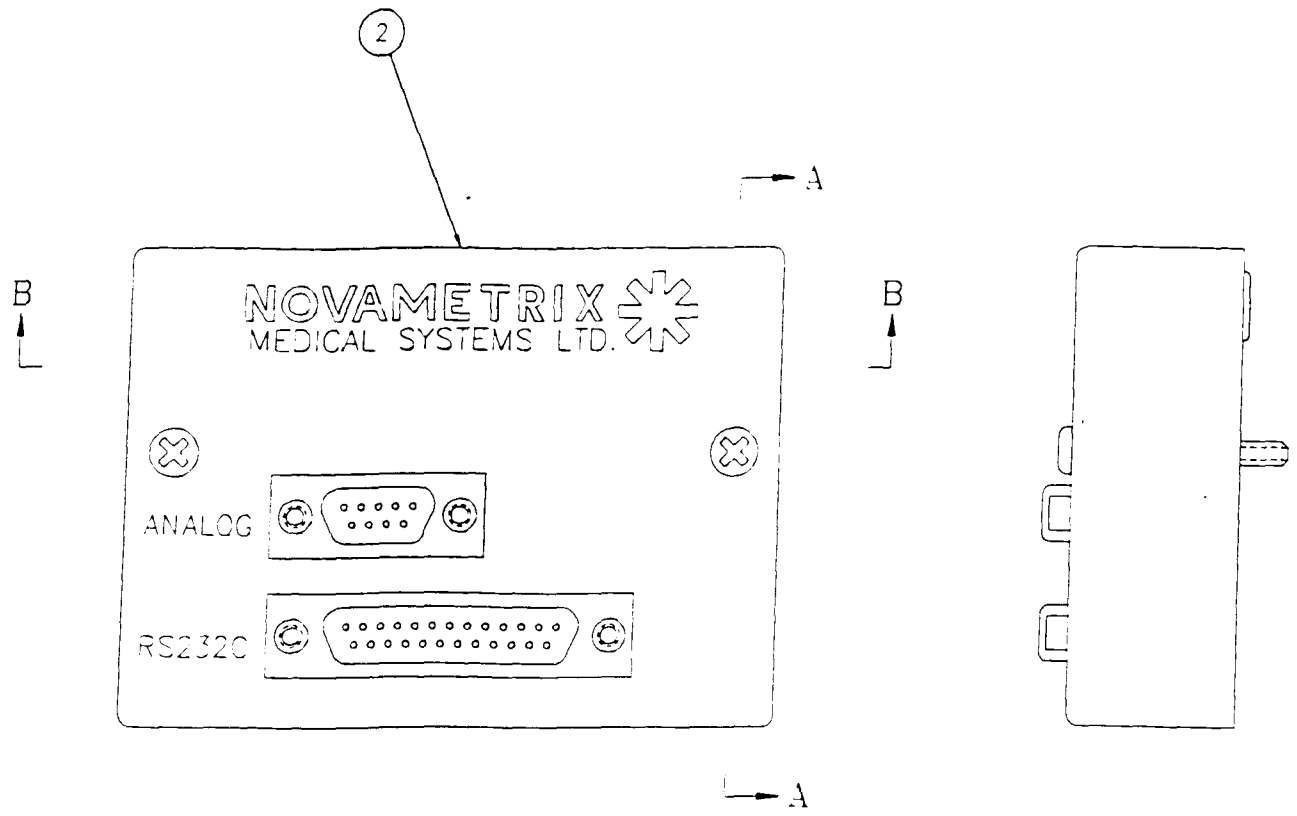


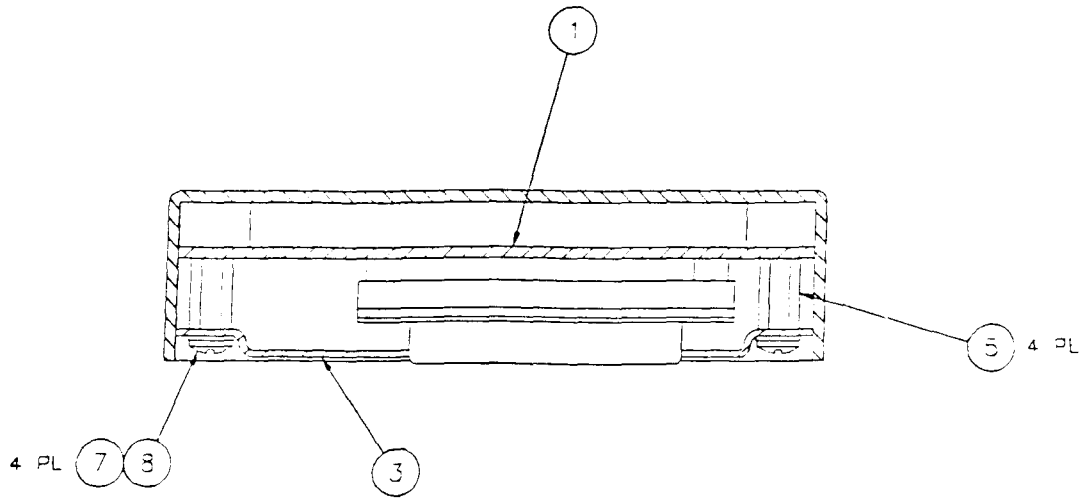






SECTION A−A





SECTION B−B

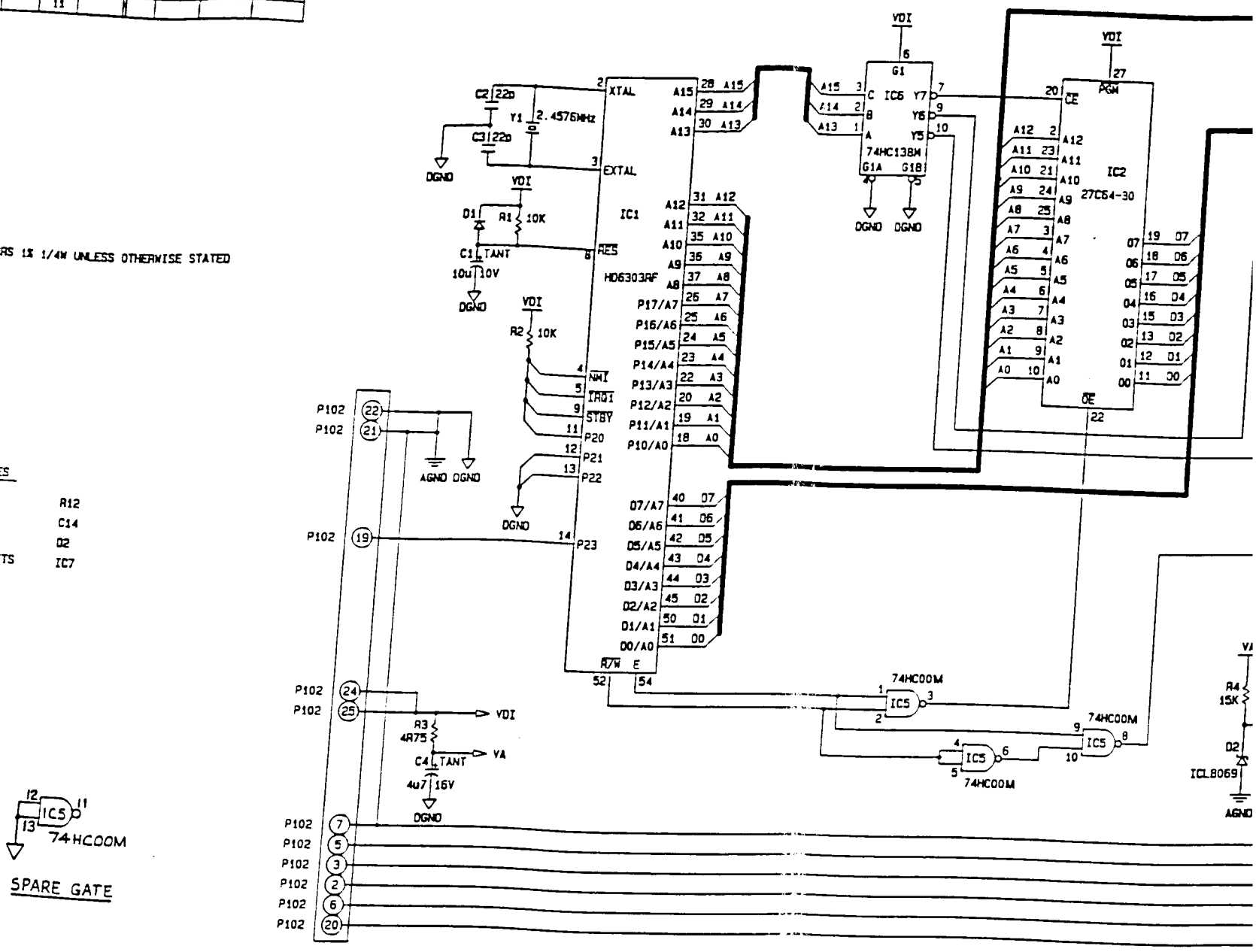
POWER SUPPLIES							DECOUPLING			
IC	TYPE	PINS	+VA	+VDI	AGND	DGND	REF	VALUE	FROM	TO
1	HD6303RF	54		27		1	C6	0u1	IC1-7	DGND
2	27C64-30	28		1, 28		14	C7	0u1	IC2-28	DGND
3	AD7528JP	20	17		1	5	C8	0u1	IC3-17	DGND
4	AD7528JP	20	17		1	5	C9	0u1	IC4-17	DGND
5	74HC00M	14		14		7	C10	0u1	IC5-14	DGND
6	74HC138M	16		16		8	C11	0u1	IC6-16	DGND
7	LM324M	14	4		11					

NOTE

ALL RESISTORS 1% 1/4W UNLESS OTHERWISE STATED

LAST USED REFERENCES

RESISTORS	R12
CAPACITORS	C14
DIODES	D2
INTEGRATED CIRCUITS	IC7



TITLE

SCHEMA
RS-23
ANALOG B

REVI	A No	BY	DATE

N Notes